THE

ELECTRICAL REVIEW.

VOL. XLVII. AUGUST 31, 1900. No. 1,188.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

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Telegraphic Address: "AGEZKAY, LONDON." Code, A B C.

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THE B.A. ELECTRICAL PAPERS.

SOME valuable information should be forthcoming next week for the benefit of those engaged in practical engineering if we may judge from the subjects to be presented at this year's meeting of the British Association to be opened next Wednesday in Bradford. Especially should this be the case in the domain of electric traction, which is the chief topic of interest, both in municipal circles and private company enterprise, at the present time. There is much still to be learnt concerning the best ways and means for carrying out electric locomotion, more particularly with regard to rapid transit, and we are glad to see that so much attention is being paid to the solution of the various problems underlying the best and most economical use of electricity for traction both in cities and between important centres of industry.

The first paper to which we draw attention is that of Mr. Mallock on "Resistance and Acceleration of Trains—Measurement of the Tractive Force," in which he proposes to give an account of the recent experiments made by him on electric and other railways to determine the acceleration, the tractive force, and the running resistance to which trains are subjected. This is an important matter, and we hope it will give rise to a really valuable discussion. As we pointed out last week, it still remains a question so far as acceleration is concerned as to whether future electric railways will employ locomotive and trailer cars, or whether each carriage shall carry its own motors.

Mr. Gisbert Kapp has recently described a meter for measuring tractive force on electric tramcars, which seems to possess some very good features; but when he tells us that air resistance has not much influence on speeds up to 30 km. per hour, he only reiterates what the late Robert Sabine published in 1883. In the ELECTRICAL REVIEW for June 16th of that year, Mr. Sabine discussed in a very admirable manner the work of an electromotor set to actuate any locomotive system in (1) accelerating the train; (2) the rolling pull; (3) adhesion of the contacts; and (4) resistance of the air. This article, entitled "Electric Locomotion—Limitation of Speed," might be consulted with advantage to-day by electric traction engineers.

Mr. Mallock's paper will be followed by some interesting particulars about the proposed Liverpool and Manchester electric high-speed railway, contributed by Sir W. H. Preece. Our readers are probably familiar with the evidence tendered before the Parliamentary Select Committee, and which was published in our issues of May 18th and 25th of this year.

The chairman of the Committee, Sir John Kennaway, said that they had heard with great interest the evidence laid before them. It appeared to them that the monorail system which was suggested for the proposed railway was likely, when fully matured, to make an important contribution to the development of railway traffic at high speed. In certain important respects, however, the present scheme was seriously incomplete. More particularly the evidence

had not satisfied them that a safe method had yet been made of effectively applying brake-power to trains running at the high rate of speed proposed. Apart, however, from such considerations, the Committee were of opinion that the proposed line had been laid out without adequate and reasonable regard to existing interests, bearing in mind that the intermediate districts did not participate in any of the advantages of the railway. The Corporation of Salford would seem to have just ground for complaint in respect of the interference of the proposed line, and the use of land at Liverpool required by the Mersey Docks and Harbour Board for the construction of additional docks had weighed seriously with the Committee. The Committee were of opinion that in all schemes put forward for giving further railway access to the heart of great cities, the question of underground approach ought to be considered and adopted where practicable. On these grounds the Committee were of opinion that the preamble of the Bill was not proved.

We hope that Sir William Preece has information to lay before the British Association, especially with regard to the effectual stopping of high speed electrical trains, which will enable the project to again be brought forward.

Mr. J. G. W. Aldridge will deal with "The Automobile for Electric Street Traction," when we may possibly hear of some developments in accumulators towards securing to our crowded streets an ideally perfect means of vehicular propulsion, as there are several secondary batteries now in course of trial which promise well. The three papers above enumerated, together with that of Mr. Gibbings on "The Design and Location of Electric Generating Stations," on a large scale for supplying electric power and lighting to large districts, are the most engaging from the heavy engineering point of view, although interest will be well sustained in the joint paper by Mr. Barker and Prof. Ewing on "A Maximum Demand Indicator."

"Animal Electricity" will form the theme of the Friday evening discourse by Prof. Gotch, and Prof. Silvanus P. Thompson is sure to be eloquent and brilliant when delivering his Saturday lecture to the operative classes on "Electricity in the Industries," a subject which lends itself to the lecturer's charming and easy style, although even he will scarcely be able to do full justice to the manifold uses of electricity in the service of man which the title of the paper indicates.

If electrical papers are less numerous than in past years there is no denying the vital importance of the subjects to be discussed, and we anticipate that the advancement of electrical engineering during the B.A. meeting of 1900 will be of a practical and enduring nature, even if the science of the subject is relegated somewhat to the background.

It would perhaps have been well had there been given an opportunity of discussing "What Pressure is Dangerous on Electric Railways with Overhead Trolley Wires." This is the subject of a series of investigations which were set on foot on account of a dissension between the eminent firm of Brown, Boveri & Co., so well known to English electricians, and the Swiss authorities regarding the proper pressure for two different electric railways to be worked by three-phase alternating current, which lines it was proposed to work at a pressure of 750 volts. This pressure being regarded as dangerous by the authorities, they refused to allow one exceeding 500 volts to be employed.

The firm requested Prof. H. F. Weber, of the Zurich Polytechnic, to give an opinion on the matter, and he made a long series of investigations of the physiological effects of the electric current on the human frame, using himself as the measuring instrument. The experiments were made with reference to the special circumstances of the above railways, where the current was supposed to be supplied through two overhead leads, the rails being used as the third conductor of the three-phase system.

Two series of experiments were made corresponding with the cases :—

(*a*) A person seizes the two bare leads with both hands simultaneously, or both of the leads fall on a bare part of the body.

(*b*) A bare part of a person standing on the railway or on a car comes into contact with one of the leads.

The main result of the experiments is that all pressures between 100 and 1,000 volts must be regarded as equally dangerous; consequently there is no reason for not using the higher pressures between 500 and 1,000 volts, especially as they lead to greater economy. Further, there was little chance of the passengers or other persons coming into contact with both leads.

The authorities are said to have allowed the use of 750 volts after Prof. Weber's investigation, a full summary of which can be found in a paper contributed to the Danish *Civilengeneer* by Mr. William Rung, C.E., of the firm of Brown, Boveri & Co. The matter is of interest to English engineers when we consider that the polyphase system has been applied to at least four tramway undertakings in the United Kingdom.

Preparatory Wiring.—It is safe to say that no large building is now erected in the United States without provision being made in it for electric lighting. At any rate, this is absolutely true of all new construction in the business centres of not only the big cities, but most of the smaller ones down to 100,000 inhabitants. A leading central station manager now informs us (writes the New York *Electrical World* in a recent editorial note) that he notes a growing disposition among architects to encourage the introduction of electric wires into domestic buildings. Speaking of a city of half a million people, he says that within the last three years he has seen big flat houses and whole blocks of residences go up without a foot of electric wire in them. This, of course, is due to the desire to make the initial cost of a building as low as possible, regardless of benefits to the occupant. But our exchange is glad to note, with the afore-mentioned manager, a distinct change in this respect. It is possible to mention also semi-rural territory, where the electric light company gets promptly after every new house and is practically securing all the new patronage that offers for illumination. That is good policy; indeed, no other should be considered by a progressive plant. If the wires are once in, the battle of introducing electric lighting and power is half fought and more than half won. Architects and builders everywhere should be encouraged to provide for wires and instal them.

Through American Glasses.—The U.S. Consul at Birmingham has been either ridiculously mis-reported, or he cannot have been to London lately. Mr. Marshall Halstead, in a recent report home, said in reference to British progress in street electric lighting :—"A few of the main thoroughfares of London will soon be electrically lighted, some poles having recently been put into position. A few were put up as long ago as the fall of 1896, and no doubt the success of that experiment is regarded as warranting extension on careful lines." Clearly we have to cross the Atlantic to ascertain how backward is our condition in electrical matters. But what can Mr. Halstead mean? The City of London Company alone has lighted hundreds of arc lamps in London streets for years past, not to speak of what is done by half a dozen other electric supply companies in London!

THE LEIGH ELECTRIC LIGHTING WORKS.

In the year 1895 the Corporation of Leigh applied for and obtained a provisional order. A few years later the contracts were placed, and the works are now in operation under the control of Mr. John Foster, the manager of the Gas, Water, and Electricity Department, to whom we are indebted for the information contained in this article.

As at present arranged, the buildings comprise only the engine and accumulator rooms, each 50 feet long by 32 feet wide, steam being obtained from the boilers of the Gas Department, which are arranged to utilise the waste heat given off the gas retort furnaces.

Space is left on one side of engine room to erect a boiler house when required.

The steam generating plant belonging to the Gas Department consists of two Lancashire boilers, 30 feet long by 8 feet 6 inches diameter, fitted with Deighton's patent corrugated flues, and made to work at a pressure of 130 lbs. per square inch. They were made by Messrs. Clayton, Son & Co., Limited, the whole of the mountings being of Hopkinson's make. Musgrave's superheaters are fixed immediately behind, each superheater consisting of 38 1¼-inch tubes, with the usual safety valves, thermometer pockets, &c. There are also two sets of Green's economisers erected, one set to each boiler, consisting of 96 pipes complete with scrapers and gearing.

The water for the boilers is obtained from a bore hole, and before passing into the boilers is pumped into a tank and then passed through a water-softening apparatus made by Messrs. Mather & Platt, Limited.

The steam main consists of one single main 8 inches diameter, with subsidiary mains 4 inches diameter, of lap welded steel (wrought) and wrought-iron flanges welded on; a Brooke's steam dryer and Giepel steam traps are provided.

The steam joints are made with gun-metal rings and mastic cement; the exhaust pipes are of cast-iron, 10 inches and 6 inches in diameter.

The generating plant at present comprises two coupled sets, one set consisting of a Willans & Robinson two-crank compound engine coupled to a Mather & Platt four-pole shunt-wound dynamo rated at 200 amperes 460 volts. The second set consists of a Willans & Robinson two-crank compound engine with a Mather & Platt four-pole shunt-wound dynamo, coupled at each end of the crankshaft, each dynamo being capable of giving 135 amperes at 300 volts. This set is used at present for charging the battery and for balancing. At present the engines are running non-condensing, but they can with a slight alteration be run condensing when required.

In the engine room there is an 8-ton overhead travelling crane, made by Messrs. James Carrick & Sons, Limited, of Edinburgh. It is worked by ropes from the ground floor.

The switchboard is arranged for the three-wire supply at a working pressure between the outers of 440 volts, and consists of three dynamo panels, four feeder panels, and middle wire panel. Each machine panel is complete with one minimum automatic cut-out, one field breaking switch interlocked with single pole knife switch, shunt regulating switch, ammeter, and voltmeter. There is also a Ferranti ampere-hour meter in circuit with each machine.

Leigh Electricity Works.

Each feeder panel is complete with ammeter, duplex switch, and fuses, also Thomson-Houston recording watt-meters.

The middle wire panel is complete with battery charge and discharge switches, battery emergency switches and fuses, reversible ampere-hour meters, polarised ammeter, battery voltmeter, and two Weston feeder voltmeters. The whole of the ammeters and voltmeters, with the exception of the feeder voltmeters, are of Lord Kelvin's multicellular type, Messrs. Dorman & Smith, Manchester, being the contractors for this work.

The accumulators are of the Chloride C.R. type, in lead boxes, consisting of 240 cells, having a capacity of 1,000 ampere-hours, and capable of discharging at the rate of 300 amperes for one hour without injury. The battery is fixed on one tier, with ample space to get at each cell, the regulating cells being connected to the switchboard with bare copper rods run on special insulators, and painted throughout with anti-sulphuric enamel.

The mains were supplied and laid down by the British Insulated Wire Company, Limited, and are of their three-core paper insulated, lead-covered type. The feeders were drawn into stoneware casing, the whole of the distributing mains being laid in stoneware troughs, filled up with compound. The service cables are of the two-core type, lead-covered and steel armoured, and are laid direct into the ground. At present there are two triple concentric feeders of ·25, ·15, ·25 square inch cross-section, with subsidiary feeders of ·15, ·075, ·15 square inch cross-section. The distributing mains are of ·1, ·05, ·1, and ·05, ·025, ·05 triple concentric, laid complete with the usual disconnecting boxes, &c.

The Wright demand indicator system of charging has been adopted, the price being 7d. per unit for the first hour, and 2½d. per unit afterwards. Meters and indicators are free; Chamberlain & Hookham's meters are used.

ON SOME METHODS OF DETERMINING EXPERIMENTALLY THE MOMENTS OF INERTIA OF THE ROTORS OF DYNAMOS AND ALTERNATORS.

By ALFRED HAY, B.Sc., M.I.E.E.

(*Concluded from page* 288.)

Method 2.—Another method, closely allied to the preceding one, is the following:—The machine is run up to any desired speed, and then the supply of power is suddenly cut off (by throwing off the belt or otherwise). A suitable speed indicator, by means of which the speed may be read off at any instant, is connected to the rotor, so that by taking a series of readings as the machine gradually comes to rest, the connection between ω and t may be determined. From these readings a curve may be plotted. We shall call such a curve a "retardation" curve.* The retardation curve

* The term used by German writers is *Auslaufskurve*.

enables us to obtain $d\omega/dt$ graphically. If the value of the retarding torque is denoted by T, then

$$T = -I\frac{d\omega}{dt} \qquad (2)$$

In this equation T is unknown. In order to obtain a second equation similar to (2), and by means of it to eliminate T, we mount a disc fly-wheel on the rotor shaft, and obtain a new retardation curve. If I′ stand for the moment of inertia of the disc fly-wheel, then

$$I = I'\frac{d\omega_2/dt}{d\omega_1/dt - d\omega_2/dt},$$

where $d\omega_1/dt$ and $d\omega_2/dt$ denote the angular accelerations corresponding to the *same* value of ω when the rotor is running without and with the disc fly-wheel on respectively.*

I have not tested this method experimentally, having no suitable disc fly-wheel at my disposal.

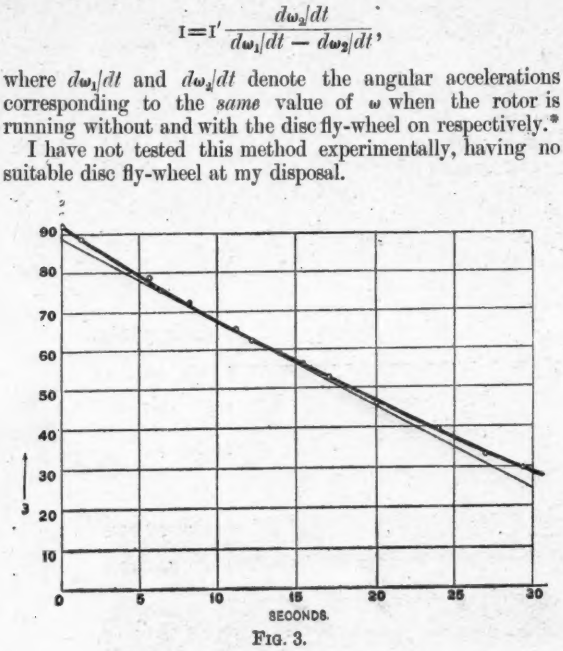


Fig. 3.

It will be noticed that the validity of this method rests on the assumption that the addition of the fly-wheel does not increase the frictional loss in the bearings, an assumption which is amply justified by practical experience.†

The two methods just described both depend on varying the value of I. The next few methods consist in either measuring the value of T in equation (2), or else in increasing or decreasing it by a known amount.

Method 3.—In applying this method, the machine under test is run as a separately excited motor, and the power supplied to the armature is carefully measured. From the total power supplied to the armature is subtracted the power lost by heating of the armature coils. The remainder then represents the power actually employed in turning the armature against the various resisting forces. Let this "driving power," expressed in watts, be denoted by w. If ω stand for the corresponding angular velocity, then the resisting torque, in C.G.S. units, is $10^7\, w/\omega$, and equation (2) becomes

$$I\frac{d\omega}{dt} = -\frac{10^7\, w}{\omega} \qquad (3)$$

The value of $\frac{d\omega}{dt}$ is found from the retardation curve.

This method was applied to find the moment of inertia of the Kapp armature mentioned above. In order to reduce the resisting torque, and so prolong the time taken by the machine to come to rest, the exciting current was reduced considerably below its normal value. A Weston voltmeter connected across the brushes was used as a speed indicator. By measuring the speed corresponding to a given voltmeter reading, and subtracting from the latter the drop due to armature resistance, the number of radians per second corresponding to one volt could be easily determined, and thus the voltmeter used as a speed indicator. The method of experimenting was as follows:—The machine having been run up to a convenient speed, the armature current was switched off, and the armature allowed to slow down. As the pointer of the voltmeter passed a certain scale division, taken as the initial reading, a stop-watch was started; this was stopped again when the voltmeter reading had diminished by a certain amount. The machine was once more run up to full speed, the current switched off, and the stop-watch started at the same initial voltmeter reading as before, and stopped at a lower reading than in the first case. By this means, the time intervals taken by the armature to come down to a number of definite speeds from a certain initial speed could be determined.

Finally, the current taken by the armature when running at one particular speed was found, and the value so obtained was used in calculating the driving power at that speed. The value of $\frac{d\omega}{dt}$ corresponding to the same speed, and obtained from the retardation curve, then furnished the means of calculating I from equation (3).

The following set of speed readings was thus obtained:—

Time	0	1·3	5·6	6·4	8·2	11·2	12·2	14	15·4	17	20
Revs. per min.	876	845	751	720	689	626	595	563	532	501	438
ω	92	88·7	78·8	75·6	72·3	65·7	62·5	59·1	55·9	52·6	46

Time	24	27	29·4	31·2	33·2	39·8	44·2	48·4
Revs. per min.	376	313	282	250	188	125	62·6	0
ω	39·5	32·9	29·6	26·2	19·7	13·1	6·6	0

The higher readings of this set are plotted in fig. 3. From the readings we find that corresponding to $\omega = 67{\cdot}7$ the value of $\frac{d\omega}{dt}$ is 2·2. The corresponding values of the counter E.M.F. and current were found to be 20·6 volts and 7·8 amperes respectively. Hence, using equation (3),

$$I = \frac{10^7 \times 20{\cdot}6 \times 7{\cdot}8}{67{\cdot}7 \times 2{\cdot}2} = 10{\cdot}8 \times 10^6 \text{ C.G.S. units},$$

a value which—considering the small size of the machine and the consequent difficulty of determining the retardation curve accurately—agrees fairly well with that found by the method of torsional vibrations.

It must be particularly noted that this and the succeeding methods are almost worthless unless due care is taken to get the bearings into a steady state. The friction is liable to vary somewhat irregularly during the first half-hour or so after the machine has been started, and in order to get a satisfactory set of readings the armature must be kept running for two or three hours, or even longer, in the case of large machines. It is hardly necessary to add that a plentiful supply of lubricant is essential in order to obtain a satisfactory set of readings.

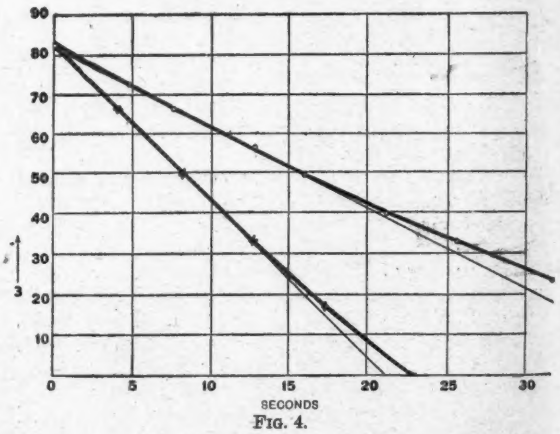


Fig. 4.

The method is obviously also applicable to alternators, the machine under test being then run as a synchronous motor, and the power supplied to it being measured by mean of a wattmeter.

* Method 2 is the one which Mr. J. R. Ashworth proposed to use.—The *Electrician*, 30, p. 459.

† Electrical Review, 46, p. 128.

A modification of this method consists in using an auxiliary motor for driving the machine under test. The losses occurring in the auxiliary motor must then be known, and the method is not so convenient.

A difficulty which will at once appeal to those accustomed to the use of graphical methods is that of determining $\frac{d\omega}{dt}$ with a sufficient degree of accuracy from the retardation curve. This difficulty is a serious one in all cases where the retardation curve cannot be determined very accurately. In the case of large machines, however, there should be not the slightest difficulty in obtaining very accurate results. Cases are on record* of some large alternators which took about an hour to come to rest when run up to full speed and then left to themselves. It is obvious that the retardation curve can then be obtained very accurately.

It must also be remembered that—as a glance at fig. 3 will show—the retardation changes very slowly, and comparatively large sections of the retardation curve closely approximate to straight lines. There is, therefore, not the same difficulty in fixing the exact direction of the curve, as that which occurs in cases where the curvature is considerable.

Method 4.—In this method, two retardation curves are obtained, one of which is the normal curve, while the other corresponds to a larger resisting torque. The increase in the resisting torque is brought about by connecting a suitable resistance across the generator terminals—an ammeter being also included in the circuit. The machine then acts as a generator, and the additional resisting torque due to the load is easily calculated from the current, the resistances of the armature and external circuit, and the speed. The additional resisting torque corresponding to any speed ω is thus known. Let it be denoted by T_0. Then

$$I = \frac{T_0}{\frac{d\omega_1}{dt} - \frac{d\omega_2}{dt}}, \qquad (4)$$

where $-d\omega_1/dt$ and $-d\omega_2/dt$ denote the retardations corresponding to the *same* speed ω in the first and second cases respectively (*i.e.*, when the machine is allowed to come to rest on open and closed circuits respectively).

It is at once obvious that to secure accuracy T_0 must be made considerable in comparison with the normal resisting torque, otherwise the difference between $\frac{d\omega_1}{dt}$ and $\frac{d\omega_2}{dt}$ will be small, and consequently the determination of I liable to a large error. For this reason, the method is much less satisfactory than the preceding one. In the case of large machines, however, it could be made to give good results, and might be applied where Method 3 is inadmissible, as, for example, where only one alternator is available, so that it has to be driven mechanically and not electrically. Wherever Method 3 can be applied, it is to be preferred.

Method 5.—This method is the one used by Routin† in some efficiency tests carried out by him in 1896. It differs from Method 4, in that the increase of retarding torque is brought about mechanically and not electrically, the second retardation curve being obtained with a known load applied to the pulley of the machine by means of a brake. In the case of large generators, there is no doubt that the method is capable of giving accurate results. If used with relatively small machines, it is not so satisfactory, as exact brake measurements then become somewhat difficult. It will then —provided the machine is driven electrically as a motor— be probably more accurate to measure the increased torque due to the brake by determining the additional electrical power required to keep the machine running with the brake rather than attempt to find it from the radius of the pulley, and the difference in the tensions at the two ends of the brake strap.

The following results, obtained with the Kapp dynamo already referred to, will serve to illustrate the use of this method. The machine was first run up to a convenient speed as a separately-excited motor, the armature current was then switched off,* and by means of a Weston voltmeter used as a speed indicator the following set of readings was obtained :—

Time ..	0	4·8	7·6	12·8	16	21·2	25·6	31·8	37·4	54·2
ω	82·7	72·8	66·2	56·3	49·6	39·7	33·1	23·2	16·6	0

A stout piece of string was then passed round the pulley, and one end loaded with a dead weight, while the other was attached to a spring balance. On switching off the current, the following readings were obtained :—

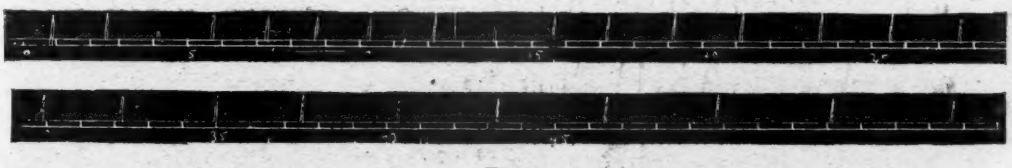


Fig. 5.

Fig. 6.

Time ..	0	4·2	8·2	12·6	17·4	22·8
.. ..	82·7	66·2	49·6	33·1	16·6	0

In order to make sure that no change in the frictional resistances had taken place during the time required to take the two sets of readings, the first set was repeated immediately after completing the second set, with the following results :—

Time	0	7·6	16·2	25·4	31·8	37	54·2
ω	82·7	66·2	49·6	33·1	23·2	16·6	0

This is in satisfactory agreement with the first set of readings, and shows that a steady state had been reached.

The two sets of readings are plotted in fig. 4, and at the points corresponding to $\omega = 60$ tangents to the respective curves are drawn. It will be noticed that for a considerable distance the curves are indistinguishable from their tangents, so that the latter may be drawn with a very fair degree of

* *Elektrotechnische Zeitschrift*, Vol. xx., p. 393.
† *Eclairage Electrique*, October 24th, 1896.

* The machine, of course, having been kept running for a sufficiently long time (about 2 hours) to enable the frictional resistances to reach a steady state.

accuracy. The directions of the two tangents give, corresponding to $\omega = 60$,

$$-\frac{d\omega_1}{dt} = 2{\cdot}04, \text{ and } -\frac{d\omega_2}{dt} = 3{\cdot}9,$$

so that $$\frac{d\omega_1}{dt} - \frac{d\omega_2}{dt} = 1{\cdot}86.$$

It was further found that with the given excitation, a speed of one radian per second corresponded to ·297 volt, and that the increase in the armature current produced by the application of the brake amounted to 6·6 amperes. Hence $T_0 = {\cdot}297 \times 6{\cdot}6 \times 10^7 = 19{\cdot}6 \times 10^6$ C.G.S. units. Using equation (4), we find finally

$$I = \frac{19{\cdot}6}{1{\cdot}86} \times 10^6 = 10{\cdot}54 \times 10^6 \text{ C.G.S. units,}$$

a value which is in very fair agreement with those previously obtained by Methods 1 and 3. The mean of the three determinations is $10{\cdot}6 \times 10^6$, and this differs by less than 2 per cent. from any one of the three values. For practical purposes, such an agreement may be regarded as more than sufficient.

It must be borne in mind that the machine experimented on was a very small one. With larger machines the accuracy of the measurement could be very greatly increased, and when the output approaches or exceeds about 100 KW., there would probably be no difficulty in measuring the value of I with an error considerably below 1 per cent.

I had intended applying some of the methods described to the Pyke & Harris alternator as well as to the Kapp dynamo, in order to test their practical value still further. Unfortunately, although the alternator rotor took an even longer time to come to rest than the armature of the Kapp dynamo, an exact determination of its retardation curves proved, after a number of fruitless efforts, quite impossible, on account of the voltmeters which acted as speed indicators not being sufficiently dead-beat, and distorting the retardation curve into a number of waves corresponding to the natural oscillations of the voltmeter needle. The voltmeters tried were the well known Ayrton-Mather electrostatic instruments; however excellent these may be in other respects, the large moment of inertia of their needles and the entire absence of any damping arrangement rendered them quite useless for the particular purpose in hand.

The method described of taking readings for the retardation curve is a tedious one, as it necessitates constant restarting of the machine. It need not, however, be used in the case of *larger* machines, for then—provided there are two observers, one to take the time, and the other to signal when the voltmeter pointer passes consecutive scale divisions—the entire set of readings may be obtained in the course of a single run. With small machines, such as the one experimented on, this simpler method is inadmissible, the readings following each other much too rapidly. Both these methods involve the use of apparatus and instruments which are to be found in every testing room. If the use of special forms of apparatus be not excluded, then even in the case of smaller machines much time may be saved by using a smoked recording drum, such as those which are to be found in every physiological laboratory. Two styles are maintained in contact with the smoked paper on the revolving drum. One of these is periodically lifted by clockwork, and marks time, while the other is attached to the armature of a tiny signalling electro-magnet joined up in circuit with a cell and key. If such a recording apparatus is available, it certainly affords by far the simplest method of obtaining the retardation curves. Samples of records obtained in this manner are shown in figs. 5 and 6. Fig. 5 refers to the Kapp dynamo, and fig. 6 to the Pyke & Harris alternator. The latter record exhibits clearly the great irregularities due to the oscillations of the voltmeter needle, which are superposed on the true readings corresponding to the retardation curve.

My thanks are due to Prof. C. S. Sherrington, F.R.S., for the use of the recording drum, by means of which figs. 5 and 6 were obtained; and to my assistant, Mr. E. H. Morgan, for able and willing help in carrying out the experiments.

CURRENT SPECIFICATIONS.

XXVI.—PORTSMOUTH ELECTRIC TRAMWAY POWER STATION.

SUMMARY.

Extent of Contract.—Complete equipment of the electric power station now being erected for traction work by the Portsmouth Corporation. Offers are only considered for the whole of the work.

Number and Type of Boilers.—Three to be supplied, of water-tube straight tube type, each capable of evaporating 12,000 lbs. of water per hour at a working pressure of 160 lbs. per square inch.

Superheaters.—Each boiler to be fitted with a superheater of sufficient capacity to superheat the steam from 100° to 120° F. above normal temperature at working pressure.

Type and Size of Engines.—Two to be supplied of horizontal cross-compound type with Corliss valves, each capable of developing 640 I.H.P. as normal load under economical conditions, and 900 I.H.P. as maximum load, working condensing with 150 lbs. square inch steam pressure. One horizontal tandem compound engine with Corliss valves to develop 320 I.H.P. as normal, and 450 I.H.P. as maximum load under above conditions.

Speed of Engines.—All engines to run at same speed, which must be not less than 90 and not more than 100 revolutions per minute.

Guaranteed Steam Consumption.—For the larger engines not to exceed 14·5 lbs. per I.H.P.-hour, working condensing with 150 lbs. square inch pressure, and for the smaller engine under similar conditions 15 lbs. per I.H P.-hour. Tests to be taken at approximately full load with 24-inch vacuum.

Type and Output of Dynamos.—To be directly coupled to the engines in each case, the two large machines to develop 400 KW. as normal full load, and the smaller one 200 KW.

Voltage and Temperature Rise.—The voltage of each machine to be 500 volts at no load, rising to 550 volts at constant speed at full load. Temperature rise measured thermometrically after 24 hours' full load run not to exceed 45° C. (81° F.) above surrounding atmosphere.

Dynamo Efficiency.—Not to be less than 95 per cent. at full load, and 93¾ per cent. at half load.

Specified Overload.—25 per cent. for periods of one hour, and 50 per cent. for few minutes without sparking.

Specified Pipework.—All as shown on drawings supplied, and to comply with specifications.

Number and Size of Condensers.—Three of Admiralty surface type to be supplied, two capable of dealing with 12,000 lbs. of steam per hour the other 6,000 lbs. per hour.

Air and Circulating Pumps.—A steam-driven combined air and circulating pump to be provided for each condenser.

Cooling Tower.—One to be provided divided into two sections, each capable of dealing with the cooling water of one of above large condensers. Motor-driven fans to be supplied and fitted.

Boiler Feed Pumps.—Two to be supplied of double acting type, with compound cylinders, one to deliver 24,000 lbs., and the other 12,000 lbs. of water per hour against 160 lbs. square inch boiler pressure.

Fuel Economiser.—To be arranged as shown on drawing, 192 tube size, fitted with Lundell direct current motor for driving scrapers, and suitable for use with 160 lbs. square inch boiler pressure.

Switchboard.—To consist of marble panels, fitted with instruments as specified.

Crane.—To be capable of lifting 25 tons, suitable for a span of 47 feet 6 inches, and for working by hand power.

Specified Date of Completion.—To be stated by tenderer in his offer.

Penalty for Late Completion.—One per cent. of total contract sum per week.

Specified Terms of Payment.—80 per cent. of value of work executed and delivered as work proceeds, 10 per cent. on completion of entire contract, 10 per cent. at end of six months' period of maintenance.

Stipulations as to Removal of Foreman.—See comments below.

Stipulations as to Wages paid to Workmen.—Unsatisfactory; see comments below.

Arbitration.—Very unsatisfactory; see notes below.

Date for Receipt of Tenders.—September 4th, 1900.

This specification has been prepared by Mr. E. Rotter, A.M.I.C.E., the tramways engineer to the Corporation. From a technical point of view there is little to take objection to, though in several cases it would appear that certain types of apparatus were in the writer's mind, and that offers for these would, from their strict compliance with the letter of the specification, be likely to receive preferential consideration. As regards the guarantees for the steam dynamos, the absence of any monetary valuation of slight variations from the stated amounts renders the following stipulation extremely stringent :—

If, as shown by the tests, the above guarantees are not complied with, the Corporation shall have the option of *rejecting the engine or dynamo, retaining its use, however, free of expense to the Corporation* until such time as they are able to obtain another engine or dynamo.

The general conditions accompanying the specification contain several objectionable features, and should be carefully perused by all making offers for the work.

Dealing first with the power reserved for the engineer, we find in Clause 4 :—

Should any discrepancies appear or misunderstanding arise *as to the meaning or import of the specifications or drawings*, or about the quality or dimensions of the materials, or the proper execution of the works under this contract, or as to extras or deductions, *or any other matter or thing arising out of this contract*, the same shall be explained by the engineer, and *his explanation shall be final and binding upon the contractor and the Corporation*, and the contractor is to execute the work according to such explanation, and without charge payable by the Corporation.

and Clause 38 :—

Any doubts, disputes, or differences arising as to the due and proper fulfilment of this contract, or relating to the construction, incidents, or consequences of the said specification, general conditions, plans or drawings of this contract respectively, or to the determination of the contract, *shall be referred to the engineer, whose award shall be final, conclusive, and binding on both the Corporation and the contractor;* and *it shall not be competent for the contractor or the Corporation to except at law or in equity to any hearing or determination before or of the said engineer*, and further, that the submission herein contained may be made a rule of Her Majesty's High Court of Justice, on the application of either of the said parties.

We have often in these columns protested against limitations of the right of appeal to arbitration, and, in some instances, to the placing of the engineer in the position of arbitrator of his own case, but this is one of the most unjust claims we have yet had occasion to examine. All appeals, of whatever nature, are to be made to the engineer who prepared the specification, and who is responsible to his employers for its suitability for the end in view. His rulings are to be accepted both by the contractor and by his direct employers without demur, and both parties are even to waive their right to contest his decisions in a court in law. In fact, his decision upon application of either party "may be made a rule of Her Majesty's High Court of Justice."

How different are these claims to the wording decided upon as fair by the representatives of both the members of the Municipal Electrical Association and the Electrical Plant Manufacturers' Association, which reads as follows :—

In case any dispute or difference shall arise between the purchaser, or his engineer on his behalf, and the contractor, either during the progress of the works, or after the determination, abandonment, or breach of the contract, as to the construction of the contract, or as to the reasonableness of any extra charge, or as to the withholding by the engineer of any certificate to which the contractor may claim to be entitled, then either party may, within 72 hours, but not later, give to the other notice in writing of the existence of such dispute or difference, and such dispute or difference may be referred to arbitration, which arbitration shall be deemed to be a submission to arbitration, within the meaning of the Arbitration Act, 1889.

We strongly advise all tenderers to refuse to agree to any such abrogation of their just rights as demanded in the general conditions attached to the specification, and to take their stand on the standard clause as printed above.

The following clause might be taken advantage of, as when preparing a tender it is quite impossible to foretell how much of the work may be required to be done at night. The contractor may not consider night work necessary, but presumably if the engineer so wills he may be compelled to work continuously night and day. If this means that all necessary artificial light may have to be provided by the contractor, the *risk* is one which may prove to be a very serious one.

The works are, *without extra charge*, to be carried on *day and night without intermission*, should there be any cause whatsoever, which *in the judgment of the engineer* shall require it.

If it should be required thus to work continuously a fair readjustment of the contract sum should be made to cover the extra cost of so doing.

The amount of surety demanded is far in excess of usual practice. Twenty per cent. of the contract sum is a very usual figure, but in this contract—

The contractor shall find *two good and substantial sureties to the satisfaction of the Corporation, to be jointly and severally bound with him each in the sum of* £10,000 *for the due fulfilment of his contract* in all its parts according to the true intent and meaning of the foregoing specification and these conditions, and for the due completion and delivery of the works at the time hereinbefore mentioned, or at the time to which the time hereinbefore mentioned may be hereafter extended, and the names and abodes of such sureties and *a consent in writing signed by them to become bound as such sureties, shall accompany the tender to be sent in.*

As at present worded, the engineer has full power to vary the work to be done under the contract and also the contract sum to any extent he deems desirable. Thus Clause 16 reads :—

No part of the work shall be altered from that shown on the drawings or described in the specification without the express sanction of the engineer; but should it be deemed expedient by the Corporation or the engineer at any time while the works are in hand to increase *or diminish* the dimensions, quantity of material, or work, or alter the situation, or *vary the form or dimensions of any part of the said works*, the Corporation or the engineer shall have full power so to do, and to order and direct any such increase, *diminution*, or alteration to be made, and that without in any way vitiating or affecting this contract; and the contractor shall, in pursuance of such order and directions as he may receive in writing, but not otherwise, execute the works thereby ordered and directed and in conformity therewith, and *the difference of expense* occasioned by such increase, *diminution*, or alteration so ordered and directed, shall be added to *or deducted* from the amount of the contract agreeably to the rates specified in the schedule of prices attached to the tender of the contractor; and where the rates are not contained in the said schedule of prices, *the engineer shall ascertain the amount of such additions or deductions;* but if any extra additional or different works be proceeded with or executed by the contractor, without previous orders given in writing under the hand of the engineer, no charge for the same will be allowed.

We advise that in tendering the operation of this clause should, at any rate as regards reduction in the contract sum, be limited to *10 per cent.* of the total. While it is not likely that extensive reductions will be made, in view of the absolute powers conferred by the general conditions upon the engineer, it is necessary that all unfair risks be allowed for or limited in operation.

It has been necessary to adversely criticise some of the clauses of this specification; it is only fair that we commend the manner in which the required contract drawings are specified. It often happens that owing to the loose way in which these are enumerated much trouble is the result; but as no one can complain that there is any doubt in this case as to the number of drawings demanded. The clause dealing with this matter reads :—

The contractor shall, within one calendar month from the date of acceptance of his tender, submit for the approval of the engineer such complete working drawings of the whole of the machinery, plant and apparatus comprised in the contract, together with such working drawings of all foundations, seatings, or supports of any kind required for and in connection with the machinery, plant and apparatus hereinbefore referred to, as may be required by the engineer for the proper carrying out of the work.

Two copies of each drawing or tracing linen are to be supplied, one of which shall be signed by the contractor after it has been approved by the engineer, the other copy will be signed by the engineer and returned to the contractor.

These drawings shall be, and shall be held to be, the working drawings of the contract, and they shall not be departed from, altered, or varied in any way whatsoever, except by the order or consent of the engineer given in writing.

Before commencing any of the works the contractor shall also supply, at his own expense, a complete set of white sun prints of the signed drawings for the use of the engineer and his assistant on the works. These drawings to become the property of the Corporation.

The engineer retains the usual right to object to any foreman or workman employed on the premises by the contractor, and claims not only the power to ask for the *removal* of any persons so objected to, but also that of demanding their *dismissal* by the contractor. It is our opinion that the powers of the engineer in this respect ought not to go beyond demanding the removal from work on this special contract; the contractor is the person who engages and pays the employé, and it is for him, and him alone, to decide whether such an one shall continue in his service at work on another contract. In place of the word dismiss, the clause should read—"*remove any such person objected to from work on this contract.*"

In the formal offer the tenderer is asked to declare that :—

He pays not less than the Trade Union rate of wage, and that he observes the hours of labour and conditions recognised and in practice obtained by the Trade Unionists in the place or places where the work is executed.

We are thoroughly in sympathy with the principle that a fair wage should be paid to all who take part in municipal, or for the matter of that, any other contract. It does not, however, seem to us that this end will be best attained by the

enforcement of such a clause as the above, which has the appearance of having been drawn up with the object of satisfying the demands of the extreme labour party.

As worded it places the contractor at the mercy of a possible and probable minority of their own workpeople, for it is well known that the works of the principal electrical contractors are so distributed over the country, that the local branch of the Trade Union is composed almost entirely of employés of that particular firm. Where there is general contentment with the existing relations between employer and employed, it is usually difficult for a Trade Union to recruit members, and under these circumstances by agreeing to the above a contractor might place himself wholly in the power of an organisation anxious to gain as much influence and authority amongst his workpeople as possible.

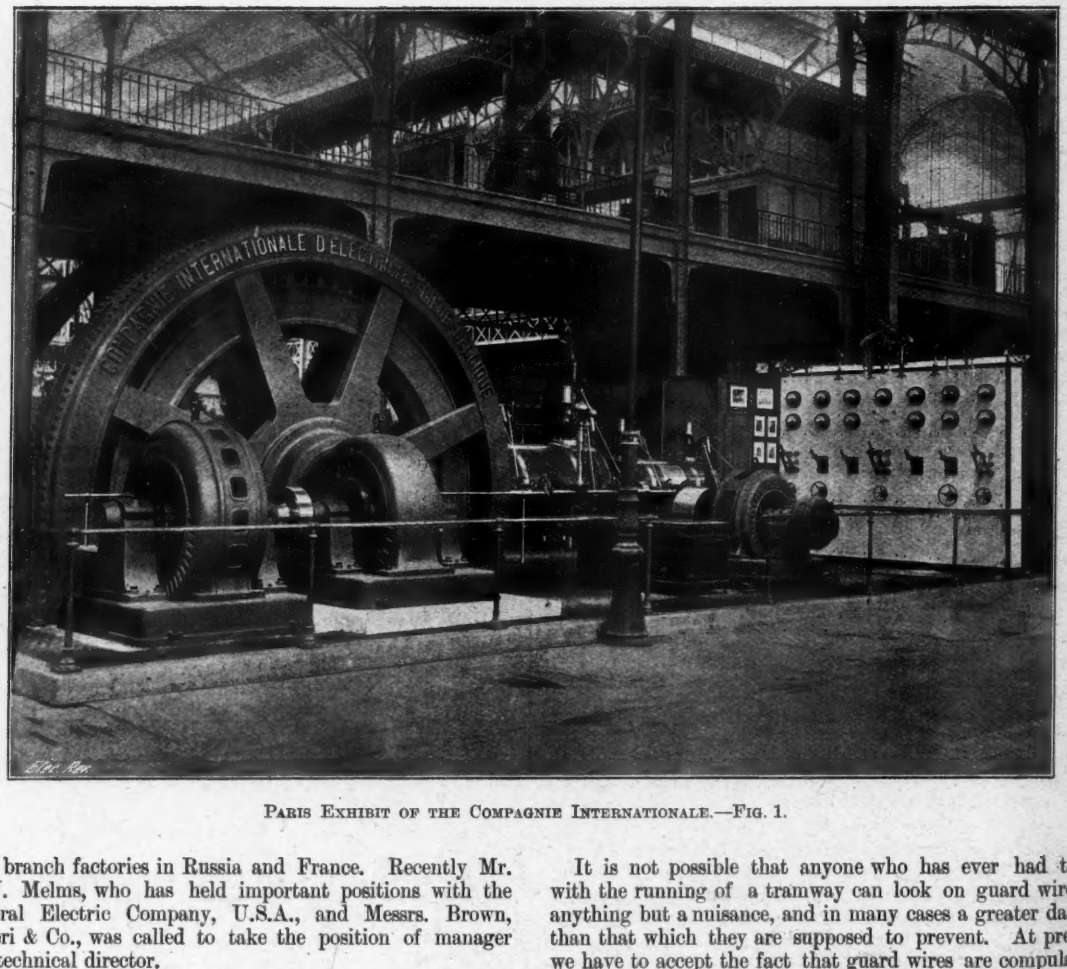
The same result could be attained, in our opinion, in a far more satisfactory manner by a stipulation that "fair and just wages were to be paid, and conditions of labour enforced," it being clearly understood that if in the opinion of either purchaser or workman this requirement was not being carried out, that an appeal to the judgment of an independent authority could be made, whose decision should be binding upon the contractor.

THE PARIS EXHIBIT OF THE COMPAGNIE INTERNATIONALE D'ELECTRICITE, OF LIEGE.

This company was founded at Liège in 1889 by Mr. Henry Pieper, and from very small beginnings has grown to be one of the most important electrical works on the Continent, with branch factories in Russia and France. Recently Mr. G. J. Melms, who has held important positions with the General Electric Company, U.S.A., and Messrs. Brown, Boveri & Co., was called to take the position of manager and technical director.

Figs. 1 and 2 show part of the firm's exhibit at the Exhibition. The large alternator has a capacity of 1,000 kw., and gives three-phase current at 2,200 volts, 50 cycles per second, the speed being 83⅓ revolutions per minute. It is driven by a compound horizontal engine by Van den Kerchove. The alternator has 72 poles, is excited at 110 volts from a 23-kw. machine, the efficiency of the alternator being 94 per cent. The motor-generator in the foreground of fig. 1 consists of a 150-h.p. three-phase motor working with current at 2,200 volts 50 cycles, driving a 100-kw. continuous current dynamo giving 240 volts. The speed of the set is 410 revolutions per minute, and the efficiencies are 91½ per cent. for the motor and 92 per cent. for the dynamo. Fig. 2, another part of the Exhibition exhibit, shows two steam dynamos driven by a Willans engine, and also a 1-ton swing crane driven by electric motor. Fig. 3 shows the three-phase motor dismounted, and figs. 4 and 5 the dynamo and its armature.

It may be mentioned that the firm make a speciality of crane work, and also hauling and other machinery for mines, &c. The firm also shows motors, two-pole, four-pole, and small three-phase respectively.



Paris Exhibit of the Compagnie Internationale.—Fig. 1.

GUARD WIRES.

The paper read by Mr. Quin on this subject before the recent convention of the M.E.A. does not seem to deal as fully as could be desired with an interesting, or burning question, if one may be allowed a mild *double entendre*.

Perhaps the abstract given in the Electrical Review does not do the paper complete justice. If it does, it would seem that Mr. Quin does not see eye to eye with the majority on some points, and that some of his suggestions lack originality.

It is not possible that anyone who has ever had to do with the running of a tramway can look on guard wires as anything but a nuisance, and in many cases a greater danger than that which they are supposed to prevent. At present we have to accept the fact that guard wires are compulsory, and, until reason prevails, we shall have to grin as pleasantly as we can in the midst of broken wires shorting the line, and bear the imposition. The usual method of guard

wiring is fairly cheap to erect, but maintenance is a more or less constant drain on revenue, and most tramway authorities would be only too glad to bear a portion, or all, of the expense of bunching overhead wires, say, every ¼ mile in a town, and of running them in a drawn-in culvert under and across the tracks. Once out of sight there would be a load of anxiety and expense lifted from the minds of those responsible for the running of the tramway. The overhead

Paris Exhibit of the Compagnie Internationale.—Fig. 2.

hammock method of bunching is cheaper than, and nearly as good as, the underground method.

Mr. Quin's objections to it are that the hammock itself is unsightly, and that the mesh is so large that a broken wire might fall through and dangle on the trolley line. It seems to us that a hammock crossing a street at infrequent intervals is much less unsightly than two wires (or four on a double track) with their supports in the shape of brackets or span-wires running the whole length of that street. The hammock would be so much above the trolley wires as to be out of the reach of a jumping trolley pole. It would be advisable to earth the anchorages of the hammock, to prevent trouble if the whole thing fell across the trolley lines.

As for the mesh being too large, there does not appear to be any reason why it should not be made smaller; but even with a 2 or 3 feet mesh, a broken wire could not touch the trolley wires if the hammock cleared by *more* than 2 or 3 feet.

The hammock method seems to be the most hopeful solution of the trouble as things are at present.

It is a matter of fairly common knowledge that a prominent official of the B.O.T. has the tramway man's hatred of the present method, and is said to favour reasonable bunching with hammock protection.

The Post Office have sometimes insisted that the guard wires themselves should be laced, to provide protection to any parallel running wire; but such work is most objectionable, and should be strenuously opposed.

After all, if overhead wires are to be bunched, what could be safer than one or more multicore cables saddled to an earthed steel span? No hammock would be required, and the unsightliness would be rather lessened.

Mr. Quin is wrong, surely, when he states that wood strips are *largely used* as a protection against falling wires. The idea is terribly crude, and the system, in practice, altogether unreliable. We have known several short circuits to have been avoided by wires falling across these wood strips, but more by good luck than anything else. The clips do not hold, and the strips are either pushed along by the trolley wheels till they are brought up by a hanger, or they turn completely round, and form very efficient insulators. On the Continent, or in the States, these strips may be largely used, although it is very improbable; but it would be interesting to learn what British lines have lately adopted the method. As a matter of fact, the authorities do not recognise this as an efficient protection, and the B.O.T. usually state that "Efficient *guard wires* shall be erected . . . . . where telephone and telegraph wires cross above the electric conductors."

Dealing with Mr. Quin's seven "suggestions" at the end of the paper :—

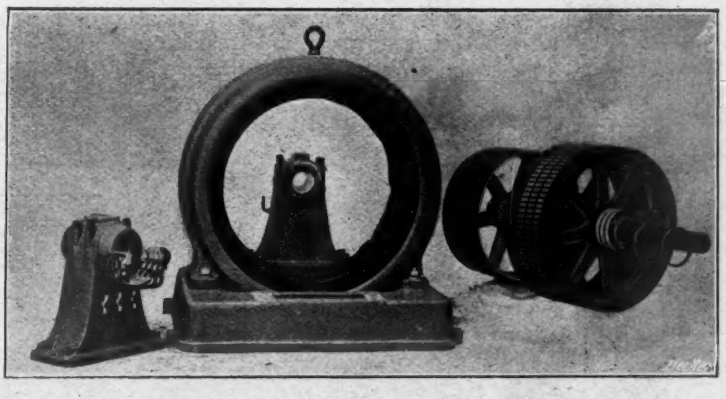
1. "The erection of two guard-wires 18 inches apart and 2 feet maximum above trolley line."—It is very patent that this is not original in any way; where guard wires are erected the B.O.T. see that it is carried out.

2. Stipulates that a falling wire must not be able to cross an unguarded length of trolley wire.—Obviously no method is efficient if it does not comply with this; but, with only two guard wires it is one thing to put them wherever a blown wire may fall, and quite another to ensure protection. Absolute protection could be obtained only by building a roof over the trolley wires.

3. Each span to be distinct, and separate from the next. This is quite unnecessary, and, to be carried out logically, would mean that every span was anchored back to the next pole at either end. Certainly there should be a limit set to the length of a guard wire, say from three to four spans, and each length should be anchored; but on the intermediate spans it is necessary only to bind or clamp the wire to the support.

4. No insulators to be used, and (5) terminals of each length of guard wire to be bonded to the rails.

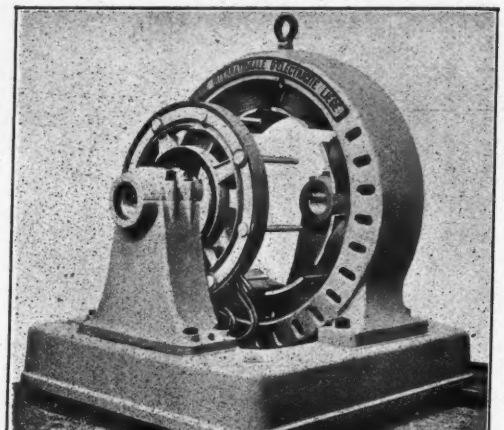
At the beginning of the paper the author's reasons for these suggestions are given. Of course, it would be absurd



Paris Exhibit of the Compagnie Internationale.—Fig. 3.—3-Phase Motor.

to insulate, and we doubt if the practice is ever followed. The terminations of each length of wire should be bonded to the pole, and the pole to the rails, but the use of insulators to support the wire is to be recommended. An insulator affords a good means for binding-in at the points of support, and its smooth surface protects the wire from abrasion. Of course, an insulator would be only used for these purposes because it weathers well, and is cheap and handy. On bracket-arm construction, the guard wire

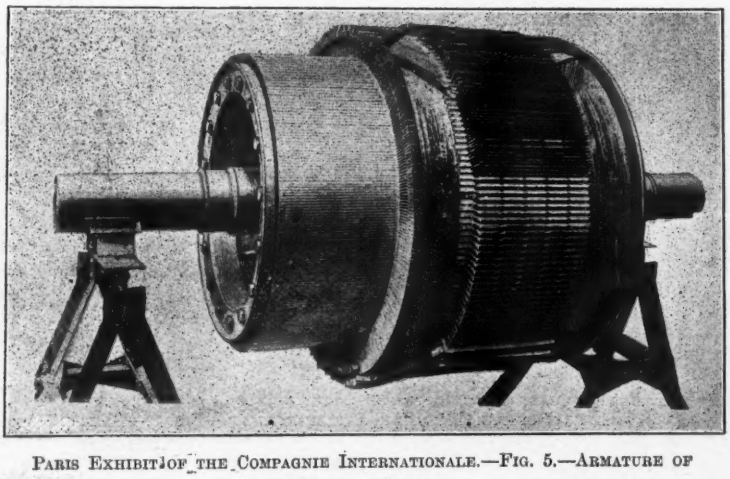
standard can be screwed into, or cast with, a special half-clamp, which serves also as the top half of the hanger clamp, and *then* insulators would serve their original purpose as well as the others; for, if a hanger bolt-insulator breaks down,



Paris Exhibit of the Compagnie Internationale.—Fig. 4.—300-kw. Multipolar Dynamo without Armature.

the line will not be earthed through the bracket arm and pole so long as the secondary insulation between the bracket arm and the combined hanger and guard wire bracket clamp is maintained. Only one instance is known to the writer when guard wires really were a blessing. Platelayers, working on a certain line about half a mile from a terminus, cut the track, and forgot to bond across the gap. Nevertheless, the cars left on the far side to maintain the service continued to run as usual, until, after several hours, through traffic was resumed. When the facts leaked out the matter was investigated, and it was found that two No. 8 steel guard wires bridging the gap, and bonded to the rails at either end, had carried the return current. The ground was very dry at the time, and could have transmitted practically no current.

6. The trolley line to be divided into sections, and each protected by a maximum current device. Length of section to be proportioned for equal maximum working currents.



Paris Exhibit of the Compagnie Internationale.—Fig. 5.—Armature of Multipolar Dynamo.

Everyone must know that the B.O.T. insist on the division into sections not longer than half a mile, so that the first part of this suggestion is redundant.

The utility of circuit breakers or fuses in every section box is open to doubt.

Sections under a quarter of a mile long would be absurdly short, and over half a mile long they are forbidden to be, so it is difficult to see how the last part of the suggestion could be worked with any benefit, even if it were possible in most cases to predict with any accuracy what the maximum working current will be on every section at any future time.

7. Difficult as it is to persuade the Post Office to further any really sound suggestion, it would be doubly difficult to get them to insert a "fusible metal bridge" at the terminations of each span of wire crossing trolley lines.

It might not be impossible to persuade them to place a delicate fuse cut-out in circuit with the nearest instruments, where any fault would be immediately observed and located.

It would be well if the B.O.T. could come to the same decision as some Americans, who have tried guard-wiring and abandoned it as a dangerous and expensive method of inadequate protection.

ELECTRICITY UP TO DATE—AND BEYOND.

Fearful and wonderful as are many of the attributes of electricity to the man in the street, the *ultima Thule* has now been reached, according to our esteemed contemporary the *Daily Mail*.

"TESLA'S LATEST MARVEL.—Transmitting Electricity without Loss,"

form the headlines of an article which begins with the words—"Niagara Falls to light the streets of London, and cook the dinners of its 5 million inhabitants," and ends with the brutally practical consideration that "the cost of the insulation is the only factor to be considered." How electricity is to be transmitted without loss is explained with that airy indifference to such trifling obstacles as physical impossibilities that is characteristic of the efforts of the lay press when dealing with technical questions. In the early days of electric lighting it used to be said that most electrical engineers could lawfully claim descent from Ananias and Sapphira, but even the expert witness might be expected to develop a conscience if called upon to substantiate some of the means suggested by the *Daily Mail* by which electricity is to be transmitted without loss. For instance, the following gems of thought are worth quoting:—

"The chief difficulty to be faced in the long-distance transmission of electricity is the power lost in the line by reason of its resistance, which fritters the current down to heat." Apparently the E.M.F. is spared this indignity.

But how wonderful is the intelligence which, in the description of a difficulty, contrives to imply the way of escape! Of course, we can see with half an eye from this delphic utterance, that all that has to be done is to eliminate the resistance, and the difficulty will vanish. Then the master mind that prompted the article, in a few pithy sentences, shows how simply this may be done.

"A trough will extend across the entire continent of America, or across the Atlantic. In the trough will be placed sawdust and water." [It may reasonably be assumed that the act of "placing" the water when crossing the bottom of the Atlantic will be a work of supererogation.]

"A thin metal tube, capable of resisting a pressure of 300 lbs. to the square inch, will be used for the purpose of transmitting the current to long distances." [Note, only *one* tube—so simple.]

"The trough is to be buried 5 or 6 feet below the surface." [Presumably below the surface of the bottom of the Atlantic; but "buried" is a horribly suggestive word.]

"A current of gas, probably hydrogen, will be forced through a pipe submerged in the substance to be frozen.

The hydrogen will be reduced to — 200° C., which will suffice to freeze the material, and *neutralise the heat generated by the passage of the electricity.*"

The italics are ours. Why is any heat generated? Transmission without loss means conductors without resistance, hence absence of heat. But if heat be generated, the neutralisation comes a day after the fair, as far as any saving is concerned. It would be better, if we might hazard a suggestion, to neutralise the resistance.

Nothing is said about the cost of producing the "gas at — 200° C.," or the quantity that will be required, nor is the somewhat delicate subject touched upon of labour troubles which might ensue if workmen were asked to break up and make good the bottom of the Atlantic under a pressure of anything from 2 tons per square inch upwards. What would the fish say to a cold streak at the bottom of their home? They might strike, and be joined by horses and birds out of sympathy. The possible prospect of fish refusing to be caught, horses refusing to move, and birds declining to fly, ought surely to awaken some sense of responsibility in Mr. Tesla's breast!

But we have not exhausted the possibilities of this system. Mr. Tesla is stated to believe that his new system of insulation is "indispensable to telephone and telegraph companies." The inclusion of each telephone wire in a trough filled with sawdust and water, and reduced to — 200° C., opens up some pleasing prospects on the overhead system.

Mr. Tesla is stated to believe, further, that no electricity will be wasted in transmission, and that "water-power converted into electricity will be carried thousands of miles." Query, in a trough?

The *Daily Mail*, in concluding, points out that, "by Mr. Tesla's invention, there is now practically no limit to the distance to which electricity may be conveyed."

The *Daily Mail* has spoken. We have, therefore, reached finality, and we may imagine interplanetary space mapped out, in the near future, into districts by troughs of sawdust and water at — 200° C., and agencies appointed in each of the more important planets for the supply of electricity on sale or return. Why not? it would be just as easy as to "trough" the bottom of the Atlantic.

THE SLABY-ARCO SYSTEM OF WIRELESS TELEGRAPHY.

The Slaby-Arco system, as described in a pamphlet issued by the General Electric Company of Berlin, though based on essentially the same principles as the Marconi system, differs

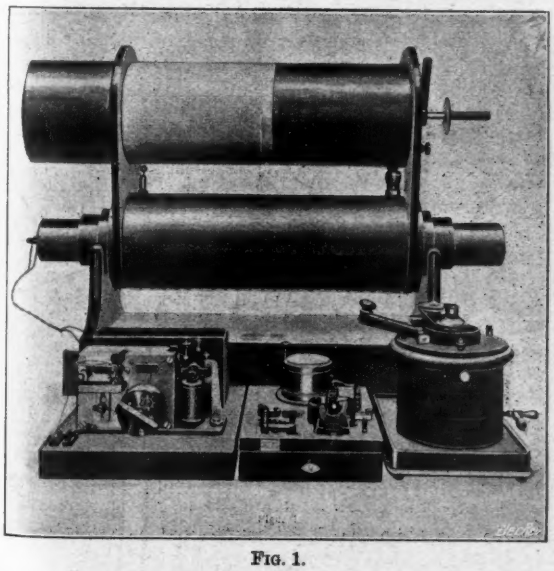


Fig. 1.

from the latter in some important respects. The vertical wire, for example, which is insulated in the Marconi arrangement, is in the Slaby-Arco system connected with earth for both transmitting and receiving.

The connections of the transmitting apparatus are shown in diagram 1. A condenser, C, is charged with high tension

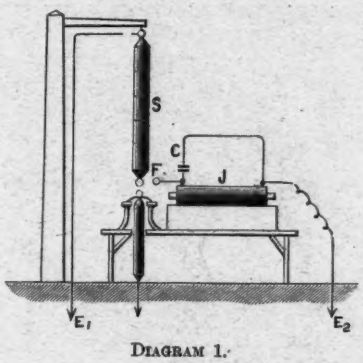


Diagram 1.

electricity by the induction coil, J, and discharges itself on one side through the spark-gap, F, and the transmitting wire, and on the other side through E, direct to earth. According to the inventors the technical advantages of this arrangement are very decided, for as only one of the condenser plates and one knob of the radiator—parts which can be permanently insulated, and from which danger to the operators can be completely prevented—are at a high potential relative to the earth, difficulties of insulating the transmitting wire are obviated; and even on taking hold of the wire scarcely perceptible shocks are felt.

For the production of the high potential the inventors ordinarily use a 40 or 50 cm. induction coil with a mercury turbine contact breaker; the coil may be directly connected with an electric light circuit thus dispensing with accumulators or dry cells. The use of a special Morse key is rendered unnecessary by a suitable appliance fitted to the turbine contact breaker. If an alternating current is available the arrangement becomes still simpler and more convenient, since in that case the contact breaker can be wholly dispensed with, and the induction coil can be directly connected with the alternating current circuit. The condensers used are made of "micanite," and are mounted on the induction coil itself, this being done in such a way that the high tension pole of the induction coil and of the condenser is protected from contact. (See fig. 1.)

The arrangement of the receiving apparatus is shown in diagram 2. In this figure S is the aerial wire netting, F the coherer, R the relay of the Morse instrument, and B the battery.

The action of the receiver is such that, when the initial high resistance of the coherer has been reduced by the etheric waves, the battery, B, is enabled to send a current through the relay, the aerial wire, and earth.

It is a characteristic feature of the receiving apparatus that the pulsating magnetic field produced by the transmitter may be received not only on a simple aerial wire, but also on an earthed wire cage or netting, whereas in previous arrangements the waves which reached the coherer, F, were shunted by the local circuit, and their effect was thereby weakened; in the Slaby-Arco system the series arrangement adopted completely removes this defect; atmospheric disturbances are also greatly diminished by the series arrangement.

Another improvement in the receiver consists in the introduction of an automatic interruption of the coherer circuit. Matters are so arranged that the blow of the tapper is only given to the coherer tube after the tension of the coherer elements is taken off. By this means not only is easy and satisfactory decoherence effected, but the life of the coherer is said to be considerably prolonged, since the sparks on breaking circuit, which would otherwise occur in the interior and would gradually destroy the coherer powder, are caused to take place externally.

A further improvement is claimed in the construction of the coherer, a variation in the sensitiveness of which is rendered possible by means of hermetically sealed leads. The

coherers are all tested for long distances, but each receiver for movable stations is furnished with an appliance for diminishing the intensity, so that the apparatus, in spite of its great sensitiveness, will work perfectly even at very short distances.

It is claimed that the system is particularly useful for communications between ships at sea or ships and the coast,

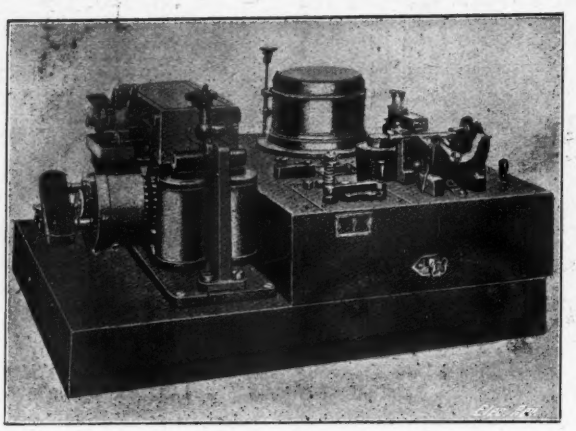


Fig. 2.—Receiving Apparatus.

and that experiments carried out by the German Navy prove that for such purposes the system is perfectly reliable.

At present the radiating power and sensitiveness of the apparatus is such that signals can be *safely* transmitted to distances of 25 to 28 miles over sea with vertical wires 38 to 44 yards high.

On land the General Electric Company maintain communication between their cable factory at Oberschöneweide and their central office in Berlin, a distance of 9⅓ miles. The vertical wires, about 55 yards high, are supported by two tall chimneys.

The advantages of the Slaby-Arco system, as compared with other systems, consists, it is stated, not so much in its

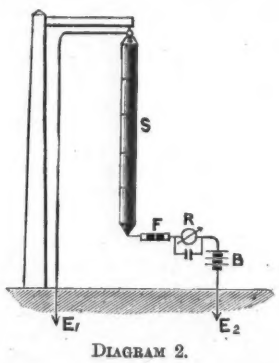


Diagram 2.

superiority in respect of the distances, as in its practical serviceability, prevention of danger from high pressures, avoidance of difficulties of insulation in the transmitter, and of atmospheric disturbances in the receiver, together with a greater solidity and simpler manipulation of the whole receiving apparatus. It is for these qualities that the system has been adopted by the German Navy.

ACCIDENTS FROM OVERHEAD WIRES.

The accident which has recently occurred on the Liverpool Corporation tramways is extremely regrettable, not only because it has occasioned loss of life, but also for the fact that it is likely to cause a scare among those municipalities which are pledged to adopt overhead electric traction. Yet a careful study of the circumstances surrounding the incident does not justify an alarmist attitude; still less would it warrant general conclusions as to the dangers of the overhead wire system. It goes without saying that any system which, after an extended trial, proved to be dangerous to life and limb would need to be most rigidly suppressed; but, in spite of the accident at Liverpool, one could not with fairness assume that overhead wires are too dangerous for English streets. We are not going to offer a plea for the system; we are mainly anxious that it should have a fair hearing, and if it could be shown that the weight of evidence demonstrates its unfitness as a mode of traction, then we would urge its abolition.

The facts surrounding the incident at Liverpool show that on the 3rd inst. William M'Gurn, a labourer employed by the Corporation Tramways Committee, was working in Robson Street, Everton, when a strap attached to the pole bearing the overhead electric wires for the tramways gave way. The falling wire and attachment struck M'Gurn on the head, fracturing his skull and causing death. At the time of the occurrence there was a violent thunderstorm and gale of wind, and the question was raised as to whether this had not something to do with causing the iron strap to give way. Evidence was given by workmen employed by Messrs. Blackwell & Co., electrical engineers, the contractors for the Liverpool Overhead Electrical System, that the strap in question was tested by tapping before it was fixed to the pole. It then rang as if sound, and no defect could be detected in it. Mr. Thomas Davies, consulting engineer, Liverpool, stated that the material from which the strap was made was not of the best quality. In the neck there was a defect which he believed had existed before the strap was galvanised. He did not think the sound test used by workmen was of any use, as, with a flaw, a piece of galvanised iron might ring as if perfect. He thought the straps used for fastening the electric equipment to poles should be tested after they were galvanised, if such a process was thought necessary. He did not think the strain in this case caused the break, but that the defective material was responsible for it. Mr. Alexander Brodie, city engineer, agreed that there had been a defect in the material of the strap which gave way, but he did not think it could have been patent to the workman who fastened it to the pole. The jury found that death was accidental and was caused by a defect in the band, which had probably been caused in the course of bending on the anvil. They exempted the workman from blame, and recommended that the straps should be tested before being galvanised, if possible. The material, we have since been informed, was supplied to the contractors by an English firm, and of a strength to withstand a strain twice that which is ever likely to occur in practice, but as everybody knows who has had any experience with building construction, bridge work, carriage axles, and what not, iron and steel are liable to internal flaws which can neither be seen nor discovered by the usually applied tests.

It is only right to mention that the jury gave their decision after the most exhaustive inquiry and after hearing a good deal of technical evidence. Nor, judging by the reports of the inquest, does there appear to have been anything which would have justified the jury in returning any other verdict. It is quite clear that the accident was due to exceptional causes, and the probability is that a similar one will never occur again in Liverpool. Indeed, the breaking of a strap is about the last point in an overhead system one would have expected to develop weakness. Moreover, at no period is the strap subject to any severe strain; it was pointed out by one of the witnesses that the weakest part was at the bolt holes, yet at this point it would bear a strain of 9 or 10 tons. There is no doubt that the whole of an overhead wire system is subject to a constant strain; there is one on the overhead wires, on the insulators, on the straps, and on the poles. Yet the factor of safety is unusually large. It is apparent that the utmost care is taken at Liverpool to ensure safety, and as an additional safeguard the work of the contractor is carefully overhauled by the officers of the Corporation, but no matter how large may be the factor of safety which is aimed at, and notwithstanding the vigilance and care of workmen, it is against all human possibility to avoid accidents arising at some time or other. It is obvious that much may be done to guard against them, and no effort should be spared to secure safety, but occasionally all precautions and safeguards are frustated by flaws in material. It was clearly established by the evidence that

the accident arose from a flaw in the strap, and though the workman applied a prefunctory test in the way of tapping, there was apparently nothing to show that a weakness existed. Apart from the question of inutility of tapping metals to discover flaws, we doubt whether anything in the nature of a detailed test could be applied. It is one of the difficulties of testing engineering materials that complete investigation cannot be made; indeed, it would be unsafe to test every ounce of material which is employed, even if it were possible. Apparently the testing of the straps in question has been very much on the lines of other tests, and takes the form of "sampling." No doubt, as Mr. Brodie, the city engineer, pointed out, a moderate test would be an advantage, but to test a strap to its full strength might tend to weaken it. As we have suggested, it would be quite impossible to apply a rigid test to every part of the material employed on tramway construction any more than it can be applied to ordinary railroads. For instance, the method adopted in testing steel posts is, in a sense, incomplete; the usual practice is to select a few, and, after submitting these to various trials, an opinion would be formed on the bulk; yet it might happen that one post which had not been subjected to tests was extremely defective, and its faultiness might result in an accident. At the same time, to subject every post to a trial might develop the very weakness which it was desired to avoid. We suppose there is no greater care exercised anywhere than obtains on railways, yet the closest examination of rails and wheels does not always discover fractures; indeed, it is not long ago that quite a serious accident arose on one of the large railway systems from a fractured rail, yet it was shown that the roadbed and rails had been inspected quite a short time before the accident.

It is unfortunate, but nevertheless true, that progress and the increase of conveniences bring new penalties. Our railways claim many victims, and there is hardly a new industry or new enterprise which is not occasionally responsible for the death of some poor unfortunate being. In the minds of fair-dealing people, the recent accident at Liverpool will not act prejudicially against the overhead wire system. It is not necessary, but it would be easy to produce voluminous evidence which would testify to the comparative immunity of the system from accidents, and under proper conditions one can maintain with some confidence that mishaps will be rare.

The minor and subsequent mishaps in the same town, luckily unattended by any injuries to passengers or passers-by, were the result of what, with a horse-drawn car, would be termed furious driving, a practice to which we have referred on more than one occasion, and would have happened just the same if the conduit had been used instead of the overhead method.

CORRESPONDENCE.

Conduit v. Trolley.

Is it possible that the gentleman who wrote in your leading article of the 17th inst., "So far from men and horses being electrocuted, we can safely affirm that no person has been injured through a falling wire," was unaware that in the *same issue* of your esteemed journal, page 262, there was a notice of an inquest on the body of a labourer at Liverpool, killed by the fall of a wire in Robson Street?

A. M. Taylor.

[We were perfectly aware of what was appearing on our other pages, but it had not been proved when our leading article went to press, what was the real cause of the Liverpool accident, and the inquest was adjourned for further evidence. The result of the resumed inquest (August 23rd) is reported in the article on "Accidents with Overhead Wires" on the preceding page. What has happened within the past week or two does not in the least affect our criticism of Mr. Baker's "case after case in recent years." Can he or Mr. Taylor quote any previous instance in this country? —Eds. Elec. Rev.]

MUNICIPALITIES AND ELECTRICAL UNDERTAKINGS.

There are many municipalists of the advanced school who are fond of arguing that it is the paramount duty of those local authorities which own and control electricity works not to make profits. Put in another way, whatever profit is made should not be applied to the relief of rates, but rather to the lowering of the price of electricity. There can be no question that if this policy prevailed in some of the larger municipalities, and electricity were sold for cost price, it would mean a severe blow to the gas companies, and there would be a great accession to the ranks of electricity consumers if they could obtain a supply. This small "if," in our opinion, is the condition which should determine whether a municipality is to supply electricity at cost price. Primarily, all municipal works are the property of the ratepayers, and their rights being equal, it would be unfair to extend greater privileges to one class than to another. Yet this is precisely what happens at the present moment. A municipality, when commencing a supply business, selects the most likely district in which to lay the mains. Plantagenet Avenue would be favoured in such a way, while Smith Street would be neglected. In other words, a municipality would adopt exactly the same policy as a supply company, viz., cultivating the best paying districts, and neglecting those in which the prospects of profit were small. In spite of the tenets of municipalism, the commercial instincts of a Corporation differ very little from those of a joint stock company. Nor is there much in this attitude to which one could object; the members of a Corporation are naturally anxious to make their undertakings commercially successful, and having regard to the responsibility which they incur, they select the shortest cut to the profit-earning stage. We are not sure that the short cut is always the best, but it offers the fewest risks.

There has been a good deal of argument as to what is the best course to adopt with regard to the profits of a municipal enterprise, but one cannot help noting the fact that the present profits of most public electric works are obtained from an exceedingly small section of the public. It is true that in some towns there has been a greater degree of development than in others; but, speaking broadly, it cannot by any means be said that electric lighting is generally used. Nor do we think the present limited use of electricity is altogether due to the price of current, for in many instances where a public supply system exists it is impossible for many people to obtain a service. If an application is made to the municipality for a supply in a street or thoroughfare where mains are not laid, the question is at once raised as to whether it would pay to lay mains specially to meet such an application. In one case within our knowledge a London Vestry was asked if they could bring their mains into a certain street, but they refused unless some guarantee were given. We do not say such a course was not justifiable, but it does unmistakably show that some ratepayers cannot obtain the benefits of a public supply system in which they are part owners, nor at the present rate of progress does there appear to be much prospect of a speedy removal of the limits of supply. In the appropriation of profits therefore, a municipality should not overlook the fact of there being ratepayers who by reason of the exigencies of economical supply cannot receive the benefits of electric lighting. In the course of time electric lighting mains may be laid in every thoroughfare, and when this comes to pass, and electricity can be truly said to be at the service of all, then should there be no question as to what should be done with the profits. But in the present state of electricity supply when only a minority are connected to the public mains, the course to be adopted in regard to profits is not so clear. At the same time with the increase in profits, substantial reductions should certainly be made in the price of electricity, for this constitutes a most powerful aid to the extension of business. In regard to electric lighting we should certainly like to see greater activity. It is true that most electricity supply undertakings are engaged upon enlargements of their systems, but we are certainly inclined to think that some municipalities are not attacking the question in a sufficiently

comprehensive manner; neither in extending the plant nor in pushing electric lighting before the public, is there much vigour shown. We know of few cases where there are adopted systematic canvassing, circularising, and other useful aids to business; yet it is patent to all that if the methods commonly resorted to in ordinary business were imported into electrical work, there would soon result an enlarged *clientèle*. There are many public supply systems of which it is said they cannot connect further customers until new plant is erected. To be in the position of having to refuse business is always deplorable, and not always creditable; but in the case of electric lighting, where the increase of customers is expected, it hardly shows an intelligent anticipation of events when the connection of consumers has to be stopped. It is to be feared that many municipalities have become so much enamoured of new electric tramway schemes as to endanger the future of electric lighting. There is nothing more necessary than improved tramway systems, and with the advent of electrical working the reproach that has hitherto attached to English traction methods is likely to be removed; but while one highly appreciates the vigorous efforts that are being made to introduce electrical working on tramways, one cannot and ought not to lose sight of the claims of electric lighting. Important though tramway work may be, it ought not to receive greater consideration at the hands of a municipality than lighting.

As we have suggested, more vigorous methods should be adopted by municipalities in the development of their electric lighting systems, not only in bringing more forcibly home to the public the merits of electricity, but also in providing new machinery on a large enough scale. It has been notable on more than one occasion that while a municipality has cheerfully agreed to the spending of large sums of money on tramways, it has not shown any remarkable readiness to increase its lighting plant. To a great extent the matter is in the hands of the engineers, and it is for the public good that they should use every means in their power to increase the lighting plant. Too frequently has there been followed up a policy of providing machinery sufficient for the requirements of "next winter." This assumes the normal increase of consumers, but we want an abnormal increase of customers; why should we wait until the public have found out the advantages of electricity, and have determined on their own initiative to use it? Nor can the matter be left to the enterprise of the local wireman; it is too important!

While on the subject of the increase of electric lighting, it is interesting to refer to figures which show the increased consumption of electricity per inhabitant in half a dozen towns. In Manchester the units sold per inhabitant in 1897 were 5·7, but in 1899 this had risen to 9·0 units. Equally satisfactory is the rate of progress shown in Liverpool, where in 1897 the figure was 3·35 units, while it stood in 1899 at 8·8; this no doubt includes the current consumption on the tramways, but notwithstanding that the result is fairly satisfactory. Coming, however, to the smaller towns, the figures are very unequal, and perhaps less satisfactory. Considering the population of Bedford, the units sold per inhabitant are abnormally high; in 1897 they were 7·5 per head, while in 1899 this had actually risen to 15·8. It is a somewhat striking fact that Bedford with 34,000 inhabitants sold in 1899 540,146 units, and Derby with 100,000 inhabitants sold 491,061; yet Bedford shows a loss of £288, and Derby a profit of £912. In Coventry the units sold per inhabitant stood at 1·3 in 1897 and two years later at 3·7; at Nottingham for 1897 the figure was 1·4, and in 1899 4·1. Sunderland has been in this respect less fortunate, the consumption in 1897 being as low as ·99, and in 1899 3·2 units.

Annual Picnics.—About 250 of the employés of Messrs. Heaton & Smith, Limited, of Salford, held their third annual picnic on Saturday, 18th inst., at Southport, where a very enjoyable day was spent.

The staff of the Sun Electrical Company, Limited, held their first annual outing on Saturday, August 25th. The party went from Paddington to Taplow, where they embarked on the electric launch *Epsilon*. After a pleasant run on the river, dinner was partaken of at the "Complete Angler," Marlow. A further trip on the launch to Medmentam Abbey and lock was taken before tea, after which the return to Taplow was made.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending Aug. 29th, 1899.		Week ending Aug. 28th, 1900.	
Adelaide	Value £103	Adelaide	Value £141
„ Teleg. mat. ..	70	„ Teleg. wire ..	700
Alexandria. Teleg. mat.	60	„ Teleph. mat. ..	619
„ Teleg. wire ..	28	Alexandria	189
Amsterdam	160	„ Teleg. wire ..	307
Bangkok	17	Amsterdam	36
Boca. Teleg. mat. ..	270	Bahia	31
Bombay	72	Beira	60
Boulogne	40	Bombay	288
Buenos Ayres	18	Boulogne	24
„ Teleg. mat. ..	375	Buenos Ayres	973
Calcutta	498	„ Teleg. mat. ..	740
Cape Town	151	Calcutta	119
Channel Islands	553	Cape Town	308
East London	184	Durban	1,900
Fremantle	90	„ Teleph. mat. ..	90
Flushing	20	Hamburg. Teleg. mat. ..	1,200
Gothenburg. Teleg. wire ..	86	Hobart	53
Hamburg. Teleg. mat.	100	Hong Kong	340
Hong Kong	69	Lisbon. Teleg. apparatus ..	92
Iquique	85	Mauritius	74
Lyttelton	85	Nagasaki	143
Melbourne	75	Ostend	300
„ Teleg. mat. ..	830	Port Elizabeth	148
New York	29	Rockhampton	64
Port Elizabeth	19	Rotterdam. Teleg. wire ..	115
Rotterdam	11	Santos	17
Shanghai	40	Singapore	169
Singapore	1,896	Stockholm. Teleg. wire ..	38
St. Petersburg. Teleg. wire ..	59	Sydney	1,541
Stockholm. Teleg. wire ..	19	Wellington	394
Sydney	218		
„ Teleg. mat.	775		
„ Teleg. wire	572		
Toronto	120		
Wellington	21		
Wiborg	45		
Yokohama	978		
Total ..	£9,141	Total ..	£10,631

Foreign Goods Transhipped.

Barbadoes. Teleph.apprts.	Value £48
Hamburg. Elec. apparatus ..	80
Perth. Elec. motor machinery ..	159
Total ..	£287

Bankruptcy Proceedings.—A receiving order has been made against F. L. L. Lindsay, electrical and mechanical engineer, Bangor, on a creditor's petition.

A receiving order has been made against R. Foster & Co., Burnley, trading as the Nelson Electrical Engineering Company Nelson.

Dissolutions of Partnerships.—Messrs. T. Harrison and M. Brown (Harrison & Brown, electrical engineers and contractors, High Bridge, Newcastle-on-Tyne) have dissolved partnership. Mr. Brown attends to debts.

Messrs. H. Ambler & P. E. Caswell (Ambler & Caswell, electrical accessory factors, Birmingham) have dissolved partnership. Messrs. Abbott, Deeley, Hill & Co., chartered accountants, of Bennett's Hill, Birmingham, will attend to debts, &c.

Liquidation Notice.—We read in the *Glasgow Herald* that the Court of Session (Lord Low) has placed the liquidation of P. C. Middleton & Co., electrical engineers, &c., of Aberdeen, under the supervision of the Court. Messrs. R. Reid, of Aberdeen, and S. E. Simmons, of Glasgow, were appointed joint liquidators. Previous to the making of the application, the company went into voluntary liquidation, and shareholders appointed a liquidator. It was then decided to liquidate under supervision, and the liquidator resigned.

Books Received.—"The Inventor's Adviser, or Every Man's Own Patent Agent," by R. Haddan. London: Harrison and Sons. 5s.

"High Speed Steam Engines," by W. Norris and B. H. Morgan. London: P. S. King & Son. 1900. 10s. 6d. net.

"Electric Generators," by H. F. Parshall and H. M. Hobart. London: Offices of *Engineering*. 1900. 31s. 6d.

Hartlepool.—The Corporation refuse destructor, which is to work partly in conjunction with the electricity works, was opened last week.

Catalogues and Lists.—The Fuller-Wenström Electrical Manufacturing Company are circulating a price sheet of their "Regina" enclosed motors.

Messrs. Clayton & Co., electrical engineers, of Huddersfield, send us a copy of their catalogue and price list of electrical appliances, including ceiling roses, main switches and switchboards, high voltage tumbler switches and cut-outs, fuseboards, and mining bells. The head office and showrooms are at Union Works.

The Garton lightning arresters made by the Garton-Daniels Company, of Iowa, U.S.A., form the subject of a catalogue, of which we have received a copy from Messrs. Estler Bros., of Laurence Pountney Lane, E.C., the English representatives. The several types of arresters for electric light, power, and railway circuits of any voltage, direct or alternating current, are illustrated and described in this list. It is claimed for this arrester that it has no joints, pivots, or hinges. The use of flexible cable obviates their necessity, and renders the device a unique mechanical combination. If the normal current follows the discharge it is shunted through the coil, which is thereby energised, drawing the armature upward until the con-

sequent are inside the tube is destroyed. The coil then loses its power, and the armature drops of its own weight to its normal position, resting on the upper discharge carbon.

Destructor Results.—Recent tests of the Refuse Destructor at Hyde, extending over a full day of 24 hours, show a consumption of nearly 60 tons of refuse, 44 tons of water evaporated, and 16 tons of clinker. Each cell consumed nearly 10 tons, and each pound of refuse evaporated 0·783 lb. of water from and at 212°. Of the steam produced, the extravagant amount of 42·6 per cent. was used in the blast, so that the steam available per pound of refuse was only about 0·44 lb., a mere nothing hardly worth the expense of the boiler, though it represents 116 H.P. at 20 lbs. of steam per H.P.-hour. The refuse is described as of good average quality. Less blast steam would be needed if the nozzles were not in want of renewal, and the boilers are, it is stated by the engineer, badly arranged. We need hardly point out, that the place for a boiler in a scheme of refuse destruction, is beyond the zone of perfect destruction, and that evaporation should take a second place compared with thorough high temperature destruction. The final gases went to the chimney at 337° F., having entered the boiler at 1,241° mean temperature, with a maximum of 1,365°, and we may suppose a minimum of 1,100°. As 1,000° represents a red heat, destruction should be perfect. The ashpit draught is stated to be 1·25 inches. An examination of the boiler disclosed leaking tubes, so that the real efficiency must have been something less than the above figures. Even under the suggested improved conditions, it is doubtful if more than one pound of steam would be raised per pound of refuse. We have evidently got beyond the happy days when the figures bandied about by destructor faddists would hardly have disgraced best Welsh. Yet even wet refuse will destroy itself. Gardeners destroy green garden rubbish by piling it on an initially started fire of dryer stuff. As each layer of green refuse is dried, it burns and drives off the moisture in the upper layers, until the whole is consumed. Theoretically one pound of dry stuff will evaporate 15 lbs. of water. Green refuse in a heap burned slowly without excess of air, probably burns with very high efficiency because the thick mass of material intercepts all the heat that is generated, and only lets it escape in steam. But this action cannot so well be carried out in destructors, and high evaporation should not be sought at the cost of low temperature destruction.

Drop in Alternating Current Lines.—The British Westinghouse Company have reprinted, in their usual excellent style, an article on this subject from the pen of Mr. Ralph D. Mershon. The article is accompanied by a number of diagrams, and it originally appeared in the *American Electrician*. An illustrated description of the Westinghouse compensator (type F), which is based upon the principles set forth by Mr. Mershon, is also given. This instrument furnishes a means of indicating at the power station, without the use of pressure wires, the voltage delivered to the load under any conditions of drop in the transmission circuit. It accomplishes this without regard to the nature of the load, taking account of current, power factor, reactance and resistance. Some notes on standard sizes and methods of adjustment are given, also a table giving the setting of the switch-points for the different percentages of compensation for which compensators may be set. No doubt those interested will be able to obtain copies of this publication by applying at Westinghouse Building.

Easton, Anderson & Goolden, Limited.—According to a statement circulated by Mr. W. B. Peat, the liquidator, the Court under which the receivership action in the matter of this company is being controlled, has sanctioned a contract for the sale of the business of Easton, Anderson & Goolden, Limited, to a new company to be called Easton & Co., Limited. A meeting of creditors is to be held at Guildhall Tavern, E.C., on Wednesday, September 12th, at 12.30 p.m. to consider the conditional agreement. The purchase consideration payable by the new company to the old is £252,000 payable as to £27,000 in cash, £150,000 in first mortgage debenture stock, £30,000 in preference shares, and £45,000 in ordinary shares.

Electrical Progress in Germany.—*Commercial Intelligence* says that "in the field of electricity, its practical adoption and distribution, Germany, according to figures obtainable, ranks first. The development has been very rapid, and though this pace has of late been maintained it is admitted that competition is beginning to be keener. In 1896 £12,000,000 were invested in the entire electric industry of Germany, whereas to-day the capital fully reaches £35,000,000. The invested capital has thus been tripled with three years. It is noteworthy that only three great electrical companies were founded before 1890 in Germany."

Electricity in Mining.—The *British Australasian* says that the Deep Lead Electric Transmission Company's plant has been completed, and the machinery constituting the first two units of 2,500 H.P. is ready to start. The machinery for the third unit is now being erected.

Electrolytic Plating Apparatus Company v. Evans and Son.—At the Birmingham Summer Assizes, (Crown Court), before Mr. Justice Wills last week, the action brought by the Electrolytic Plating Apparatus Company, of Vittoria Street, Birmingham, and of Walsall, against Thomas Evans & Son, of Summit Works, Fieldgate, Walsall, in respect of the alleged infringement of a patent, was resumed and concluded. Mr. A. Colefax and Mr. Bucknill (instructed by Mr. Howard Smith, Walsall,) were for the plaintiffs, and Mr. Hugo Young, Q.C., and Mr. Disturnal (instructed by Messrs. Stanley and Jackson, Walsall,) for the defendants. For the following report we are indebted to the *Birmingham Daily Post*:—The action was brought to restrain the infringement of patent No. 5,274 of 1896, which was granted to Alfred Sydney Smith, Thomas Alfred Smith, Rowland John Smith, Sydney Smith, and Thomas Deakin, and had been assigned to the plaintiffs. The invention was an improved apparatus for the electro-deposition of metals, and it related to electro-plating of smaller articles, which, by the use of the apparatus, were simultaneously burnished. The allegation of the plaintiffs was that defendants had manufactured and used an apparatus made in accordance with the description of the plaintiffs' specification. Defendants, on the other hand, denied the infringement, and contended that the plaintiffs' apparatus was a different invention from theirs. His Lordship said he had come to the conclusion that judgment must be for the plaintiffs. It appeared to him that the claim was nothing like so wide as had been contended by the defendants, and the patentee must be given the benefit as well as be subjected to the disadvantage of a common knowledge which existed at the time he gave the specification. To his mind anybody who had seen the Zingzam patent would have anything in the world suggested to him rather than what had been adopted by the plaintiffs in this case. Therefore he did not think there had been any anticipation. He could not follow the statement of the defendants, that what the plaintiffs had done showed no inventive skill. Sometimes the greatest inventive skill was shown by the smallest alterations. The other inventions led to no success, whereas the modification at once gave success, and if that was not sufficient to support a patent he must go to school again for patent law. His Lordship thereupon entered judgment for the plaintiffs, and granted the injunction sought. On the application of defendants' counsel, a stay of execution was granted.

Electro-Medical Apparatus.—On Friday, August 10th, at the meeting of the British Medical Association at Ipswich, Dr. Mackenzie Davison exhibited his new stereoscopic X-ray apparatus, together with a new motor mercury break. The apparatus used was made and supplied by Messrs. Harry W. Cox, Limited, and consisted of two 10-inch coils, with record tubes and English-made screen and the motor break. The motor break consists of a slate wheel, with brass pin run through the diameter, mounted on the extended armature spindle of a small motor. The wheel is immersed in mercury to about two-thirds its diameter, the mercury being covered with water. The speed of the motor is regulated by resistance. The voltage required is 24 volts on the coils and 4 volts on the motor, but at low speed good results can be obtained with 12 volts. The whole apparatus is designed to work from 100 volts continuous circuit. The stereoscopic radiographs showed conclusively the great advantage of the apparatus in accurately locating injuries and the presence of foreign substances.

Indian Electrical Notes.—*Indian Engineering* gives the following notes regarding the progress of electrical schemes in India:—"The Government of India have accorded sanction to Mr. Gribble's electric tramway scheme for Hyderabad.—The Calcutta Tramways Bill has passed through the Bengal Legislative Council. The tramway company's electrical engineer has arrived, so we ought soon to see the construction of overhead equipment begun. The report of the company says that the contract for the electrical equipment of the lines has been concluded with Messrs. Dick, Kerr and Co. for a sum not exceeding £170,000.—Some time back Mr. J. W. Meares was to be deputed to Simla to report on the various schemes for light and power from streams in the neighbourhood. We hear that circumstances preclude an early report, and the matter remains in abeyance for some time yet.—The electric light installation at the viceregal lodge, Simla, has been carried out by a Bombay firm, and consists of three Siemens-Willans direct coupled sets, with a Tudor battery of accumulators."

Installation Work.—Messrs. Robert Dawson & Co., Limited, of Hartley Works, Stalybridge, are carrying out various electrical contracts in the provinces, including installations, plant, and so on for the East Anglian Sanatorium, Suffolk; Cottage Homes, Stoke-on-Trent; Theatre Royal, Stockport, and several large mills, &c.

National Telephone Company v. Clontarf and Hill of Howth Tramway Company.—In the Dublin High Court of Justice, before Mr. Justice Barton last week, this vacation motion was heard. From the report in the *Irish Times*, it appears that Mr. C. A. O'Connor, Q.C., with whom was Mr. H. Wilson (instructed by Mr. V. B. Dillon), for plaintiffs, applied for an order restraining defendants from interfering with the wires of the plaintiffs' electric system between Dublin and Howth, and to prevent them from laying their wires in such a way as would preclude plaintiffs from working their wires efficiently. The tramway line had been constructed along the coast from Clontarf to the Hill of Howth. There was also a line of electric wires, owned by the Telephone Company, supported by posts, along the same line. The Telephone Company were entitled to work that line under a licence from the Postmaster-General. Under their Act of 1898 the Clontarf and Hill of Howth Electrical Tramway Company were bound, in the construction of the line, to place their wires in such a position as would not interfere with the working of the Telephone Company. What the plaintiffs complained of was that the defendants had placed their wires in such close proximity to the telephone wires that the latter had now refused to act, and they were subject to frequent interruptions by the electric action of the defendants' wires. In three places the defendants had placed their wires in mechanical contact with the wires of the Telephone Company, with the result that the electric current of their system was transferred to the telephone wires, and all the latter wires were in danger of being fused along the whole system. The defendants had declined to submit the matter to the arbitration of the Board of Trade. He relied, in support of the application, on the affidavit of Mr. Frank Gill, superintendent for

Ireland of the Telephone Company, who gave specific instances of of the interruptions and dangers to which the plaintiffs were exposed through the action of the defendants in putting up their wires in such close proximity to the telephone wires. There would be no difficulty in removing and relaying defendants' wires so as to obviate all interference with the plaintiffs' wires. Counsel submitted that the Tramway Company had violated their Act of Parliament, and had declined to take the precautions imposed upon them.

Mr. Campbell, Q.C., M.P. (instructed by Messrs. O'Connor and Dudley), for plaintiffs, said they had in every way satisfied the Board of Trade, and had got the certificate of that body before they used the line. Under Section 55 of the Tramway Act the Telephone Company could lay down other wires in lieu of those they alleged were interfered with, and charge the Tramway Company with the cost. According to a letter they had from Mr. V. B. Dillon, the cost of that removal would only amount to £42. Instead of doing that the plaintiffs resorted to this extraordinary proceeding in Chancery for a mandatory injunction.

Mr. Wilson having replied,

Mr. Justice Barton said at first sight the matter seemed urgent on account of the interruption of the telephonic communication. It was admitted by both sides that the Telephone Company could set the matter right at a cost of between £40 and £50, which, if they were in the right, they could recover from the defendants. Therefore, he considered there was no urgency. There had undoubtedly been some delay already. The plaintiffs did not act with the promptitude that would entitle them to an injunction. He allowed the motion to stand till the hearing of the action, and reserved costs.

Niagara Notes.—That modern machinery possesses a very great attraction for the people of to-day, is made clear by a new step taken by the Niagara Falls Power Company in charging an admission fee to view the machinery installed in its central power station. Years ago when all the water of the Niagara plunged over the precipice of the falls unharnessed, men were plentiful who predicted that the time would come when a portion of the waters would be diverted and harnessed for man's benefit, and that the power development thus created would rival the scenery of Niagara as an attraction. While the first part of the prediction was generally accepted as something likely to occur, still the public mind of years ago was not prepared to think that the power development at Niagara would ever be a rival of the cataract. But this has now come to pass, as is shown by the first month's operation of the new plant of the Niagara Falls Power Company. It was on July 2nd that the pay system was established, and for the first month of the system the records kept show that in that time there were 1,967 paid admissions to the power plant. Of this number 913 paid the 10 cent fee charged to view the installation from the gallery, while 1,047 paid 25 cents each to go about the floor in company with the guides furnished, and have explained to them all the important features of the plant. In this way and from this source, there was collected the sum of $358, of which amount about $100 will go to pay the expense of the guides and doorkeeper in connection with the system, and the remaining $250 will go to endow free beds in the memorial hospital at Niagara Falls, for the use of the employés of the Niagara Falls Power Company. Thus it will be seen that in establishing the system, the Niagara Falls Power Company manifests no disposition to profit thereby, but lends its aid to the comfort and welfare of its employés, when they are so unfortunate as to be taken sick and forced to go to a hospital. The power station of the Niagara Falls Hydraulic Power and Manufacturing Company is located in the Niagara gorge right at the water's edge, and all the heavy parts of the machines that are therein installed, have to be lowered over the high bank by means of a derrick. Some few weeks ago a new steel derrick was installed on the edge of the cliff for this purpose, preparatory to lowering some very heavy machines. This derrick was thought to be in every way safe, but on Friday, August 10th, while a new 16-ton armature was being swung over the cliff, the derrick broke down, and the armature and all plunged down the bank. The armature fell upon and went through the roof of the inclined railway of the Cliff Paper Company, while a portion of the derrick went through the roof of the Cliff Paper Company's pulp mill located at the water's edge adjoining the power house. The armature was so badly damaged that it was necessary to order a new one. The total loss is about $25,000.

Paris Exhibition Awards.—Messrs. A. C. Wells & Co. have been awarded a silver medal at the Paris Exhibition for the "Wells Lights," also a silver medal for their "Lightning" painting machine, and in addition a "mention honorable," for their waste oil filters, "Unbreakable" lamps and oil feeders, and "Industrial" lamps.

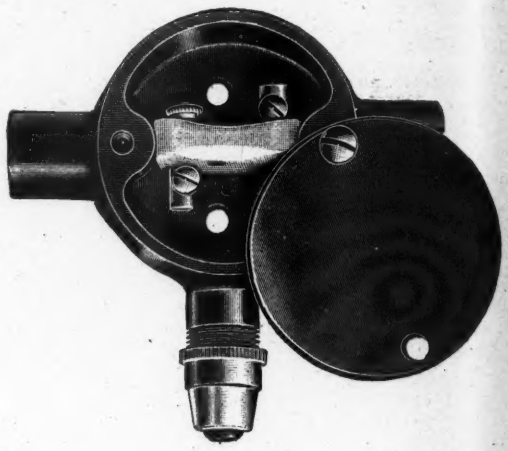
Davis & Timmins, Limited, have been awarded a gold medal at the Paris International Exhibition for their exhibit in Class 65, Group XI.

Messrs. Salviati, Jesurum & Co., Limited, of London and Venice, have been awarded a Gold Medal for their exhibit of electrical chandeliers and other fittings.

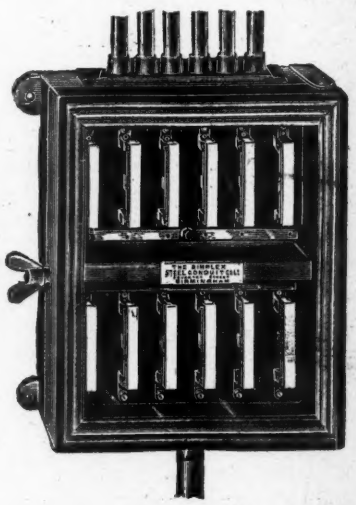
Raw Hide Gear Wheels.—Mr. W. F. Dixon, 63, Percival Street, C.-on-M., Manchester, has submitted to us samples of his manufactures, which we have carefully examined. The process he employs seems to produce most satisfactory results, the layers of hide forming what is practically a solid mass; having the transparency of horn, but infinitely harder. The blank which he sends us, shows the steel bush prior to the fitting of the end plates which are bolted right through the wheel, and give additional security in resisting strains transverse to the laminations, naturally the weakest direction in built-up wheels. The teeth are cut from these blanks as in a metal wheel. The finished wheel he sends is a well-finished article; we understand it was made 16 months ago, and was returned on being replaced by a similar wheel of larger size, the firm for whom it was made finding that they had underestimated the size required. We understand from the list sent us, that the wheel can be built up to any size. This list gives very full particulars, and may be had on application, and samples will be submitted for inspection.

Release of Trustee.—The *London Gazette* contains notification of the release of trustee (Mr. J. G. Gibson, Official Receiver) in *re* W. Dalzell (W. Dalzell & Co.), electrical engineer, of Newcastle-on-Tyne.

Simplex Conduits.—A new supplementary list, including some of the latest improvements in their steel conduit system, has been issued by the Simplex Steel Conduit Company, Limited.



Amongst other things that have been lately added are a screwed brazed conduit of heavy gauge and screwed fittings for use in places such as breweries, &c., where a water-tight system is insisted upon; split bends and tee pieces; a new type of box enamelled iron-cased switch and fuse distributing boards; pendant fittings with porcelain bridge, with connection terminals fitted; also split box with bridge terminals and a connection box for connecting up branch circuits from a pair of bars fitted on to porcelain in the box; removable porcelain interiors and connection bars for use with their standard junction boxes. This arrangement consists of a porcelain cradle



which just fits inside the junction box and supports two brass connection bars, which are each made in two parts. The bars are drilled along their length and terminal screws are fitted to clamp the branch circuit wires, and a half-lap joint in the middle allows the two ends to be easily sweated on to the main lead, it being thimble-bored to receive same. A large variety of T jointing boxes are also listed with a number of special junction boxes, &c. We have already mentioned that this company has been awarded the Gold Medal distinction at the Paris Exhibition.

Scamped Work.—An Edinburgh correspondent writes:—"For some time the Edinburgh Trades Council have had under consideration the question of the scamping of the electric light fittings in the city. The matter has been considered at three different sittings of a committee of that body, who brought up a report at a meeting of the Council on August 22nd, leaving it to the

Council to deal with the subject. Mr. Newell, of the Electrical Engineers' Association, said that what they wanted to get at was the 'scamping' of the work. Contractors for electric installations in small shops, often below tenements inhabited by many people, did the work in a very shoddy manner, with the result that the risk of disastrous fires was very great. He claimed that they had a right to have an inspector appointed who would see that this work was carried out in a proper manner, apart from the examination and test made by the Corporation's inspectors. Mr. Bell moved the adoption of the committee's report, and that they send the matter to the Electrical Engineers' Association (?). They were the parties best able to judge. If outside inspectors were appointed, one man would be required for every job on hand. Mr. Cumming seconded. Mr. Blaikie, in supporting this view, said that it was not the duty of the citizens to see that the contractors fulfilled the terms of their contract. The workman who would put in brown paper or wax-cloth to a joint was not a man, but a coward. He should have told the employer that he would not do it. Mr. Wilson said it was not so much the contractors as the contract system that was to blame. Mr. Bell's motion was then adopted unanimously."

Theatre Lighting.—The New Tivoli Theatre of Varieties, Birmingham, was opened on the 20th inst., after extensive alterations, and is electrically lighted throughout, the work being carried out by Mr. F. J. Borland, of Leeds, whose Scissors lamps are so well known for stage work, and whose experience in theatre lighting by complete plants, is well known in the provinces. The plant consists of a Tangye 40 N.H.P. gas engine, Byng-Hawkins dynamo giving 300 amperes at 120 volts, Frankenburg's cables, British Electric Works fittings, and Borland's projectors, all British made goods.

Trade Announcement.—The newly-formed Wear Electrical Engineering Company have just opened their showrooms at 56, John Street, Sunderland.

The Willoughby Destructor Syndicate, Limited.—Meetings of creditors and shareholders in this now liquidating syndicate, were held at Carey Street, W.C., on 22nd inst. The chairman stated that the company was registered on August 13th, 1898, with a nominal capital of £3,200 in 64,000 shares of 1s. each, its object being to purchase and exploit patents relating to destructor furnaces for the treatment of town refuse, and in particular certain inventions for improvements in such furnaces. It was stated that a destructor was erected at Devonport, but proved a failure, and in January, 1900, it was refused by the Devonport Corporation, who required its removal. In consequence of certain disputes in the directorate, litigation ensued and this was pending at the date of the winding-up order. The failure of the company appeared to be due to the fact that the destructor erected at Devonport did not properly carry out the work for which it was intended. The cause of this was now in dispute. After some discussion, the creditors resolved that the matter should be left in the hands of the Official Receiver as liquidator. A similar resolution was passed by the shareholders.

Works Flooded.—On Tuesday last week the Caledonia Wire Works of Messrs. Frederick Smith & Co. at Halifax were damaged by the bursting of the Corporation main sewer while a storm was in progress. Operations have been carried on at high pressure lately owing to the great rush of orders, and it was at 10 p.m., while things were in full swing, that the accident made itself felt. The galvanizing department suffered very seriously, in fact, it is stated to have been completely devastated. In the basement the engine and machinery were almost completely buried in a mass of ashes and stones washed from the hillside. The Dowson gas plant house was in 8 feet of water and dirt; 150 tons of dirt were deposited in the yard where the gasometer stands. All the departments using gas driving power are stated to be at a standstill. At the time of writing no estimate can be formed of the damage done. The Mayor and Corporation officials have visited the works. The electrical trade will not be slow in joining with us in sympathising with Messrs. Smith in this unfortunate experience. We may be pretty sure that, with their accustomed enterprise and, of course, with the assistance of the Corporation, who must recognise the benefit such an establishment as Messrs. Smith's confers upon the borough, things will be speedily set right again.

ELECTRIC LIGHT AND POWER NOTES.

Arbroath.—An installation of electric lighting is being fitted up in Brothock Spinning Mill, Arbroath, belonging to Messrs. Corsa Bros. This mill was recently rebuilt, the old mill having been destroyed by fire fully a year ago. The contract for the installation is in the hands of Messrs. Lowden Bros. & Co., of Dundee. The installation is capable of supplying 250 lights. Lights are being introduced into all departments.

Barnes.—The consulting engineer has reported to the District Council that he has appointed Mr. H. Cottrell clerk of works on the buildings for the electricity station. He has occupied a similar position at the Gloucester electricity works.

Belfast.—A gas explosion occurred in connection with the electric light mains on August 18th.

Brighouse.—The North British Electrical Supply Company has cancelled its application for electric lighting powers for Brighouse.

Burnley.—The Guardians have resolved to make application to the L.G.B. for sanction to borrow £8,000 for an electric light installation at the Workhouse, and the erection of a new boiler house and the provision of two new boilers. Messrs. Shepherd and Watney are to be employed to carry out the necessary works. The scheme includes lighting all the buildings within the boundary of the Workhouse (cottage homes, infirmaries, and all other buildings). There would be 1,538 lights. The recommendation was, that the current supplied be at 220 volts; the dynamos to be coupled direct to the engine, the latter being of the high-speed vertical type.

Bury St. Edmunds.—The inauguration of the borough electricity supply works took place on Tuesday evening.

Chester.—A Local Government Board inquiry was held last week respecting the Corporation's application for sanction to borrow £35,000 for an extension of electric lighting in the city. An original loan of £65,000 had been granted, but the Corporation wanted £35,000 more for new machinery and extension of station. The town clerk (Mr. S. Smith) stated that the Corporation started lighting at a price of 6d. a unit, but this had been reduced to 4½d., and large consumers were allowed a considerable discount. During the last three years the Corporation had sold 355,957 units, 473,656 and 617,792 units respectively. In the first period they had 83 public lamps, in the second period 236 lamps, and in the third 361, 165 of which were arc lamps. The Corporation contemplated working the trams by electricity. The provision which was being made would practically double the present building, and the extensions would suffice for working the tramways.

Consett.—Last week a deputation from the Northern Counties Electrical Supply Company waited upon the Council *re* the lighting of the district. The company wished to apply for an order, and sought the Council's consent. Referred to the Gas Committee to report.

Crieff.—The Committee to which we referred last week advises the Council to apply for a provisional order in its own right.

Devonport.—A deputation which has visited Liverpool and inquired into the street lighting there advises the Council to erect 41 electric arc lamps in seven different thoroughfares, each lamp-post to have also two incandescents for lighting at midnight.

Dublin.—On Monday an adjourned meeting of the Corporation was held to consider the report of the Electric Lighting Committee. The Committee recommended the Corporation to adopt certain tenders in connection with Mr. Hammond's scheme, to which we referred last week. A great deal of interest was taken in the meeting, owing to the fact that it was known that a proposal to supply electricity to the Corporation would be put forward by the Dublin United Tramways Company, which has already erected large plant for generating electricity for the purpose of running its system of electric trams. The proposal of the tramways company was put forward, but after a long and heated discussion the Corporation decided to keep the electric lighting of the city entirely in their own hands, rejecting the tramways company's proposal by 38 votes to 14, and accepted the tenders referred to.

Dundee.—On 20th inst. the Tramways Committee resolved to increase the salary of Mr. Tittensor from £250 to £350 on account of his work on the electric tramways, and £50 may be added a year hence.

Faversham.—The Town Council has decided to apply for a provisional order.

Grays.—Mr. Preece's report upon the tenders for electric lighting plant is in the hands of the Council.

Greenock.—The Police Board has decided to charge a minimum rate of 4½d. and 1½d. for energy for lighting and power, and 4d. and 1½d. for power only, on the Brighton system.

Halifax.—The accounts of the Corporation electricity works for the year ended March 31st show that the expansion of this department has exceeded expectation. The output has been more than doubled, the number of units sold being 1,371,333, as compared with 628,759 in the previous year. The lamps connected number 45,403, as against 32,020; the gross revenue was £16,069, as against £8,957—an increase of £7,112. The gross profits amounted to £9,001, as compared with £4,565 last year—an increase of £4,436. The average price obtained per unit., after deducting discounts, is 2·77d., as against 3·33d. last year.

Hampton Wick.—The Council has decided to receive a deputation from the Twickenham and Teddington Electricity Supply Company *re* electricity supply for the district. The company's terms are stated to be much better than those which were offered by the Kingston Corporation.

Hanley.—At this week's Council meeting the Electric Lighting Committee recommended the Council to accept a number of tenders for works required in connection with the electricity department to meet the increased demands made upon it; and also that application should be made for sanction to borrow a further sum of £7,000.—Alderman Hammersley pointed out that from

January to July they had generated at the electricity works 473,000 units, and their output—that was what they had charged their customers for—was 311,000 units only. They were exceedingly anxious to find out where the leakage could be. With regard to domestic lighting, it was found that the consumption in many cases had been so small that the meters would not register it. That was a thing they hoped to be able to remedy. The recommendations of the Committee were confirmed.

Goole.—A syndicate has given notice of intended application for a provisional order. The Council is applying for an order on its own account, and will oppose. It should be added that the Council owns the gasworks, and is jealous of outside competition.

Hastings.—A Local Government Board inquiry was held last Friday concerning an application by the Corporation to borrow £3,650 for electric lighting extensions.

Hoylake.—The District Council has appointed as its electrical engineer Mr. Ernest Marples, of the Liverpool and District Electric Lighting Committee, at a salary of £150.

Hull.—The Chamber of Trades, Drapers' Association, and Retail Grocers' Association have been holding a meeting here for the purpose of discussing the action of the local authorities in placing electrical fuse-boxes in front of business premises. The discussion turned chiefly upon the erection of one of these boxes in front of Messrs. Craft & Son's premises at the corner of Beverley Road and Fountain Road. Mr. Craft said that when he perceived it was the intention of the Electric Lighting Committee to erect a fuse-box only 5 feet 6 inches distant from one of his principal windows he wrote to the electrical engineer on the subject, but did not receive any reply, and the box was subsequently erected. It had proved, and was proving, a great inconvenience to his trade. He had drawn the attention of the committee to the matter, and had received an intimation from the town clerk that they were prepared to remove the box to another site on condition that he paid £10 towards the cost of removing it. The meeting were unanimously of the opinion that the erection of the boxes in front of tradesmen's premises was a serious inconvenience, and a deputation was appointed to wait upon the Electric Lighting Committee for the purpose of laying their views before them.

Ilford.—The foundation stone of the District Council's electricity works was laid on 25th inst. by the chairman.

Kingstown.—Messrs. Porte, Sykes & Co. have notified the Council of their wish to apply for a provisional order, but the Council will not agree. Furthermore, the Council will at once proceed to act under their already obtained order by applying to the Local Government Board for a loan, and empowering Mr. Manville to prepare plans, specifications, &c., for the installation.

Llandudno.—The Local Government Board has sanctioned the loan of £4,844 for excess expenditure in connection with the electric light and destructor works.

London.—St. George's Vestry.—A special Vestry meeting was held last week to consider the proposed electric lighting of the streets of the parish at a cost of £17,000 annually for a term of 31 years. A motion to rescind a resolution, adopting the electric light as an illuminant for the streets in the parish, was adopted by 23 votes to 13.

Westminster.—A street main box explosion occurred in Hindon Street, Pimlico, on 23rd inst.

Newbury.—Exactly 12 months ago we drew attention (Electrical Review, August 25th, 1899, p. 321) to the decision of the Newbury Council to adopt and vigorously follow up a "dog-in-the-manger policy." Its order of 1892 was to be systematically sat on but never hatched; and no outsider was to be allowed to hatch it and bring it off upon any terms whatsoever. We then said that it was time the attention of the Board of Trade were drawn to the decision. "Revocation seems to be urgently called for at Newbury." An extension of time for six months had been, as it happened, just granted, and we then remarked that it was needless delay after the matter had been shelved for so long. How true our words were appears from the issue of the *London Gazette* for August 24th, 1900, wherein we find it announced that the order has been revoked as from August 22nd. Better late than never, of course; but why was the matter allowed to drift so long when there are scores of electrical firms eager to take it up? The blocking policy of petty municipalising spirit is disastrous to electrical development.

Nuneaton.—Mr. Hawtayne's report upon the electricity works, which are now the property of the Council, was before that body last week. He reported that the site of the works was very good. He did not favour the erection of new works in combination with a destructor, but if the public baths were erected close at hand, the exhaust steam there would be utilised with advantage. He advised the erection of entirely new buildings, and new machinery, instead of utilising the old works and plant. The existing machinery might afterwards be of use in the new works. In addition to the £16,000 for the purchase of the works and erection of new plant, a further £2,000 would be required for mains, extensions, &c. The Committee last week recommended the adoption of the report, and that the matter of tenders for the new machinery be taken in hand.

Penzance.—The Council is calling in an expert to advise as to carrying the provisional order into effect.

Rhyl.—The Council sent a deputation to London the other day to inquire as to the best means of raising the £40,000 loan required for electric lighting and other public works.

Russia.—Messrs. Siemens & Halske, of St. Petersburg, have just completed the construction of a central electric lighting station in the town of Samora. The plant comprises two 105-kw. multiphase alternators, driven by two vertical compound engines of 165 h.p. each.

Sheffield.—At a meeting of the Electric Lighting Committee on Tuesday the question of the future of the electric lighting of Sheffield was discussed. Mr. Fedden, the electrical engineer, reported at length, pointing out the great demand upon the machinery at the works, and the coming need for another supply station. Mr. Fedden's report was referred to Mr. Hammond, the consulting electrical engineer to the Corporation, for his opinion. Meanwhile the Committee took an important preparatory step towards obtaining the requisite additional machinery. The necessity of obtaining the very best and most modern machinery was fully realised by the Committee, and with a view to collecting information it was decided that a deputation consisting of the chairman (Alderman Styring), the vice-chairman (Mr. W. W. Harrison)—or failing him, Mr. John Maxfield—and the engineer (Mr. Fedden) should visit the Paris Exhibition in order to examine the latest machinery there on view. After visiting the Exhibition, it is probable that the deputation will proceed to Frankfort to make further inquiries.

Surbiton.—A site for electricity works has been decided upon by the District Council.

West Bromwich.—The Corporation are making rapid progress with their electric lighting undertaking, and it is anticipated that by Christmas they will be in a position to supply consumers.

West Riding.—A number of Urban Councils in the West Riding have received notification from electrical syndicates of their intention to apply for electric lighting powers for the various districts. There is a feeling that the authorities should themselves keep this power in their own hands, and a joint meeting of the Councils is being arranged to consider the question.

Worksop.—The Board of Trade has approved the proposed system of electricity supply, but the Council now awaits the sanction of the Local Government Board.

Yeadon.—A plebiscite has been taken on the electric lighting question, with the usual unsatisfactory result. 890 papers were issued, 570 returned; of the 570, 337 were blank, coming from the people who didn't care, 95 from those who want electric light, and 75 who would rather be without it. The 98 promised to take 365 lights at 5d. per unit, or 304 at 6d. When the matter came later before the Council it was proposed to part with the provisional order to a syndicate, but the voting was equal, and the casting vote was not exercised. The period of grace under the order expires in October. Revocation is needed, if a company is prepared to take the work in hand.

ELECTRIC TRACTION NOTES.

Aberdeen.—The Council on 20th inst. resolved upon certain small extensions of the electric trolley lines. The electrical engineer and superintendent are to report as to the type of car to be adopted.

Durham.—The Houghton-le-Spring Tramways Company are commencing the preliminary arrangements in connection with their undertaking. The tramways are to be worked by electricity, and the scheme is looked forward to with some considerable interest because of its comparative magnitude. It will serve one of the most thickly-populated districts in the county of Durham, and one which is only indifferently served by the railway. When completed the system will connect the following important colliery villages:—Easington, Hetton, Houghton, Newbottle, Philadelphia, Herrington, Silksworth, Ryhope, and Grangetown. The Sunderland electrical system will ultimately run to Grangetown.

Ilford and Ham.—Progress is being made by the Ilford District Council with their undertaking to light the district by electricity, and also to work electric cars on the overhead system from Seven Kings along the High Road to Manor Park. The Ilford section is to cost £68,500, and, as our readers are already aware, in addition the East Ham Council and the West Ham Corporation are making provision—the work is well under way—for connecting with Ilford as far as electric trams are concerned. Joining at Manor Park, the East Ham section will go right through the heart of the district to North Woolwich on the one hand, and to Wanstead on the other, while the West Ham section will take in Forest Gate, Upton, Stratford, Plaistow, Canning Town, and the southern portion of the borough. The area to be covered is over 20 miles.

Liverpool.—A large party of members of the Liverpool Engineering Society visited the Pumpfields electric power station of the Corporation on 24th inst., being shown over by Messrs. Brodie, Bromley Holmes, and Bellamy, the city electrical engineers and tramway manager.

(*Continued on page* 347.)

THE BRITISH INSULATED WIRE COMPANY'S WORKS AT PRESCOT.

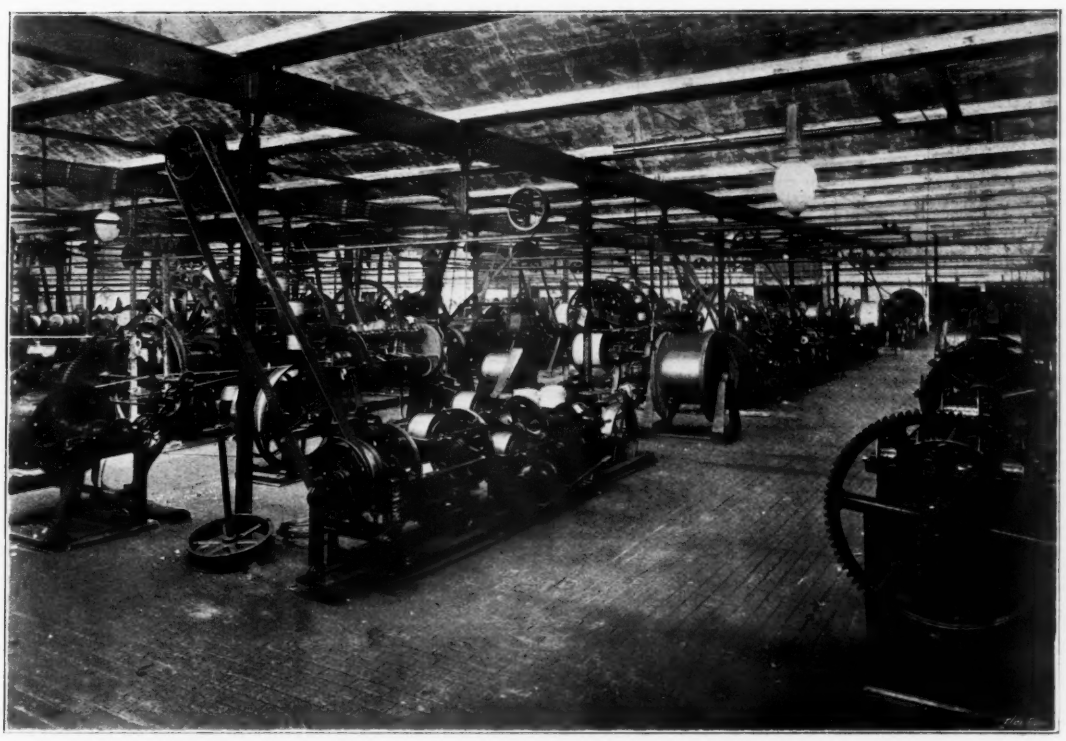
The first important application of paper-insulated cables in this country was to the high tension trunk mains between Deptford and London, in 1890, by Mr. Ferranti; prior to this, however, some progress had been made in the United States in this direction, and Mr. J. B. Atherton, while in that country, entered into relations with the patentees which resulted, on his return to England, in the formation of a company with a capital of £60,000, for the manufacture of cables of this type. A site was obtained at Prescot, Lancashire, and workshops erected thereon.

Progress, at first, was slow; perfection cannot be attained at once, and a vast amount of experimental work had to be done, special tools designed, new processes invented, before the cables reached a pitch of excellence satisfactory to their makers. The first important contract obtained by the company was for the supply of paper-insulated cables in 1891 to the City of London Electric Lighting Company, Limited, which was then commencing operations; the successful working of these cables proved their good qualities, and laid the foundation of the immense volume of business which the B.I.W. Company has carried on since then.

Once fairly started, the demand for "paper cables" grew by leaps and bounds, and in 1897 it became necessary to reconstruct the company, with a capital of £400,000, in order to provide additional workshops to cope with the orders in hand, which at the time of the transfer had a value of over £200,000. In spite, however, of the large increase which was made in the capacity of the factory, the business grew still faster, and at the present time the manufacture of cables is being carried on night and day without cessation. In addition to the demand for electric lighting and traction cables, the company has a large trade in telephone cables, which are made on its patent air space system, and is the owner of a patent system of house wiring with twin lead-covered wire.

We reproduce herewith a number of views of the interior of some of the workshops at Prescot, showing various processes in the manufacture of the cables.

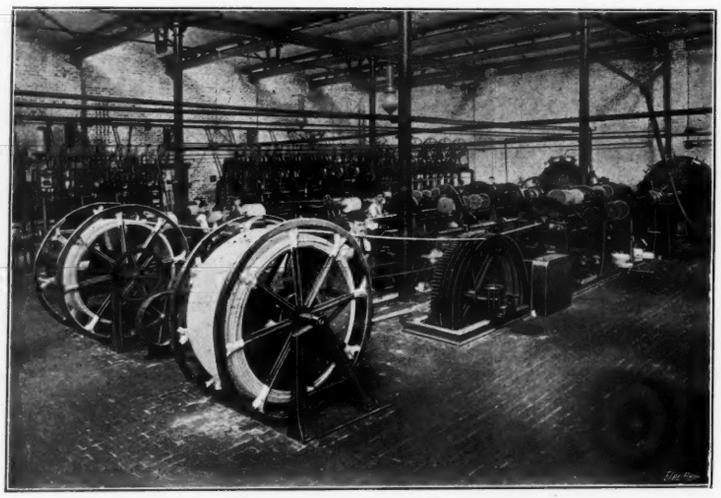
Commencing with the "old insulating shop," our view, taken from one corner, shows cabling, insulating, and wire-armouring machines of various sizes and descriptions. The cabling machines are generally similar to those used elsewhere; the copper wire (rolled and drawn on the premises) is not tinned, as the insulating materials have no corrosive effect on copper, while at the same time they form an excellent flux for soldering purposes. The insulating machines may be recognised by the numerous reels of paper, which are sloped in such a way as to ensure the even laying of the paper on the core, breaking joint but not overlapping. Several of the machines are capable of simultaneously laying up the stranded cable, and covering it with the requisite thickness of paper—which, in the case of high-voltage cables, amounts to as much as half an inch.



The Old Insulating Shop.

The paper is in the form of ribbon, the width depending upon the size of the cable in question, and is laid on in the dry state, great care being taken to prevent the access of moisture or other injurious substances in the course of the various processes. Directly a drum is filled with the insulated core, it is wheeled away, running on its flanges, to one of a series of ovens situated close to the insulating room. These ovens are divided by brick partitions into four compartments. Each of these is provided with three lines of

rails, along which the drums are wheeled into position. The ovens are maintained at a temperature of about 230° F., and the drums of cable are left in them for about 48 hours, by which time most of the moisture originally present is removed. To abstract *all* the moisture would, however, be a fatal mistake, as this would destroy the texture of the material. The ovens are fitted with a complete system of sprinklers, of the Grinnell type, but not automatic; these are supplied with water by a Worthington pump, which is always under steam, and by opening a stop valve outside it is possible to instantly extinguish a fire in any one of the ovens, should such a mishap take place. Returning to the old insulating room, we may draw attention to the large armouring machine in the middle distance. While the B.I.W. Company prefers steel tape armour, iron wire is sometimes specified, and the machine in question is capable of laying this on the largest sizes of cable made.



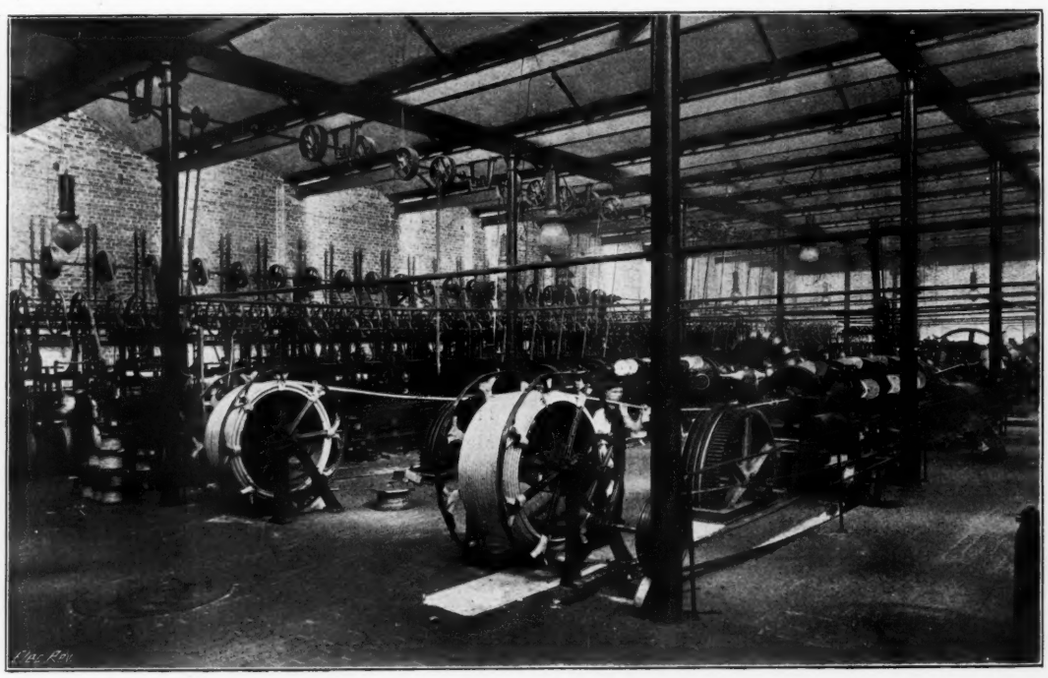
The New Insulating Room.

In this shop the twin house-wire is laid up and insulated. In this each conductor is in the form of a segment of a circle, and the two are separately insulated, laid up together in a spiral with their flat sides adjacent, so as to form a circular periphery, and the whole is again insulated overall. The segmental form is given to the wire by an automatic press, which is fed with stranded core, and presses it into the correct shape, dealing with about 1 foot at each stroke.

At the back of the shop are a number of machines for winding the copper wire on bobbins suitable for use in the stranding machines.

Hydraulic cranes are provided for handling the heavier bobbins in this shop, in which also the machines are driven by shafting.

Passing through the oven room, we come to the "new insulating room," the subject of our next illustration. Our view is taken from the middle of one side of this room, and shows two large cable machines in the foreground, each of which lays up the copper strands and covers them with the full thickness of paper in one operation. As it happens, the nearer machine is engaged in stranding the insulated cores of a three-core cable, and insulating the whole, while the machine on the left is putting on a layer of segmental copper strips over the insulated core of a concentric cable, and insulating overall. Each of the cores of a three-core cable is pressed into the shape of a sector of a circle, and the three when laid up together form the well-known "clover-leaf" cable of the B.I.W. Co. The segmental strips, on the other hand, are drawn through dies to the correct shape, their inner and outer faces being concentric with the core, and their edges being truly radial; they are guided through a plate in the operation of stranding, so as to fall in place without twisting.

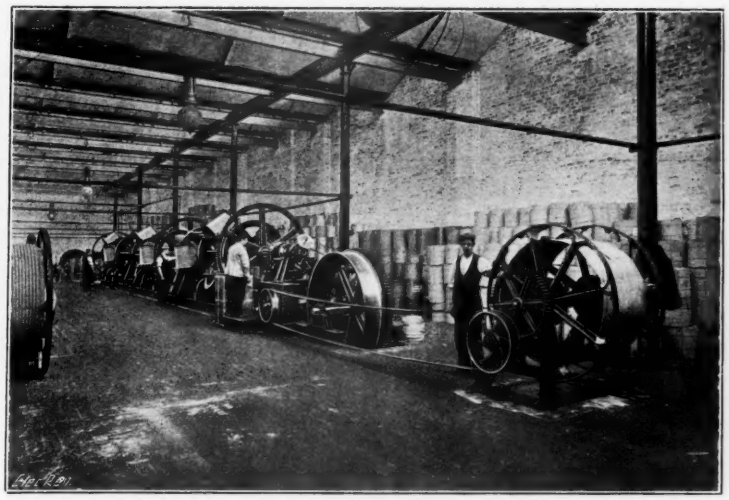


The New Insulating Room.

After each coating of paper has been applied, in the case of cables having more than one core, the operation of drying is repeated, and when laying up concentric cables the pro-

cess of saturating each inner covering with insulating oil is carried out before adding the next layer of copper. The core, in fact, passes from a tank of the hot composition direct to the machine.

Behind the large units may be seen two long rows of smaller machines extending the whole width of the shop. These machines are used for covering and pairing telephone wires. In the former case, in order to enclose the wire in a comparatively large open tube of paper, the paper ribbon is not lapped round the wire as usual, but is laid up parallel with it, and passed through a die to give the tubular shape; to retain the ribbon in position the tube is lapped round with an open spiral of cotton thread—the whole process being exceedingly simple and ingenious. In the pairing machines the lead and return wires, thus insulated, are twisted up in a spiral with a long lay to prevent cross induction.



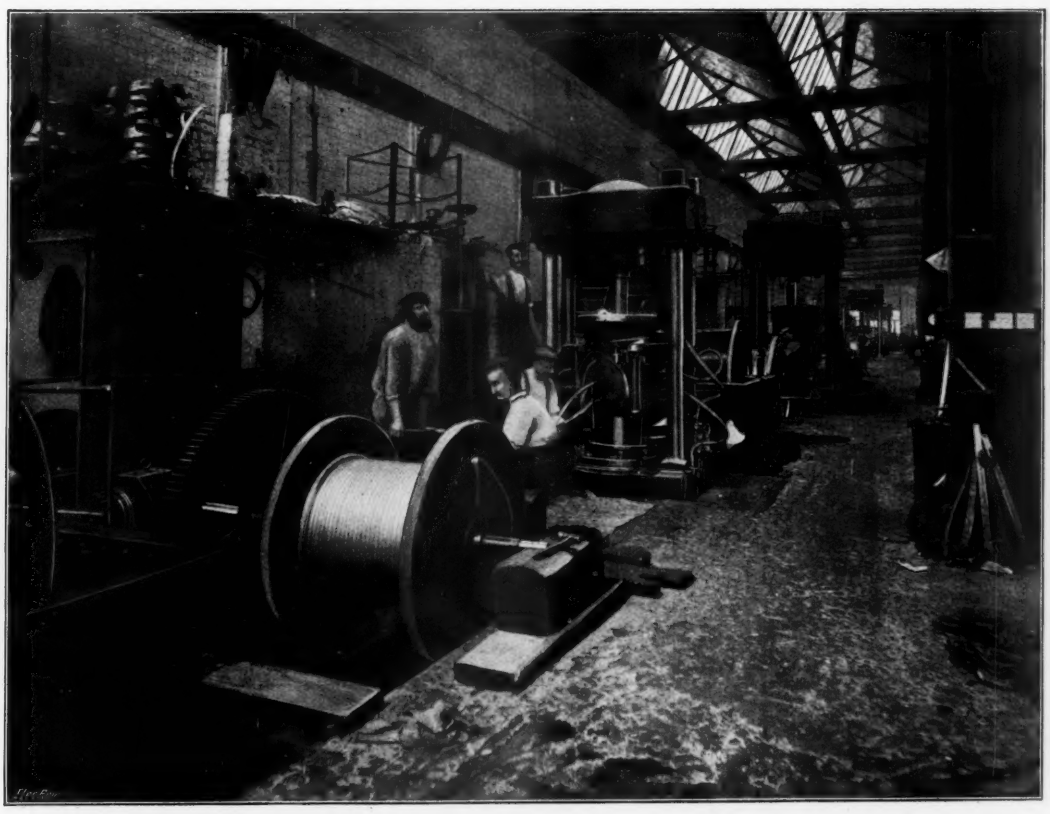
Large Stranding Machine.

them on reels ready for the machines. These large rolls of paper are "rough dried" before hand cutting, each roll, which weighs about 90 lbs., losing 2 lbs. or so of moisture.

There are in all six large machines, 80 telephone wire machines, and 25 pairing machines in this shop. Four additional large machines are on order.

The telephone machines are capable of turning out half a mile of twin wire each per day, so that 1 mile of 300 pair telephone cable can be produced every week. All the machines in this shop are driven by electric motors, chiefly of the open type, and an electric crane is also in use.

At the far end of the shop is a very large stranding machine, originally designed for the manufacture of the telephone trunk line cable between London and Birmingham. As the cable consisted of 38 pairs of extremely heavy conductors, no machine in existence at the time



Hydraulic Presses.

We give a view also of the remoter corner of this shop, showing two more large machines laying up and insulating concentric cables, more telephone wire machines, and a row of paper cutters. The latter slit up the rolls of paper received from the manufacturers into narrow strips, and wind

was capable of doing the work. The machine was constructed in four sections bolted together, each of which was capable of carrying 6 bobbins; one of these sections has since been detached, three only appearing in our view. Although designed for a special purpose, the machine is

capable of doing various kinds of stranding work, and is constantly in use.

The next process through which the cables (except telephone cables) have to pass is that of impregnation with the insulating composition. This is carried out for the most part in the lead press shop, in a series of iron tanks, which have been largely added to quite recently. An extension is also being built out from this shop, to contain the mixing vats and apparatus. The tanks are heated during the process by zigzag copper steam pipes.

Wire-drawing Plant.

Immediately after this operation the cables are sheathed with lead, and this is the most interesting process of all. There is a series of eight hydraulic presses, some of which are shown in our illustration; the largest, the second in the figure, has a water ram 33 inches in diameter, and as the available water pressure is 3 tons per square inch (produced by a battery of pumps driven by electric motors), the total pressure on the ram may amount to over 2,500 tons!

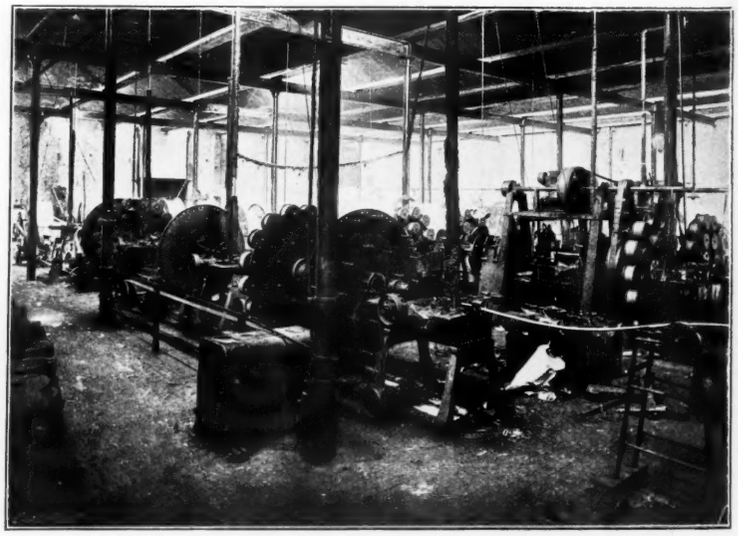
The cable passes from an oil tank into the press through an inwardly projecting nozzle rather larger in internal diameter than the cable; the nozzle, which is made of steel of the highest quality, terminates in a thin cylindrical extension, which projects within another nozzle, so that no part of the cable is exposed to the direct pressure of the lead. The thickness of the lead is regulated by the amount of overlap of the nozzles, which can be adjusted from without. The operation is as follows: The cylinder being filled with lead at a temperature at which it is plastic, but not fluid, is pushed up by the ram until a fixed ram above it comes in contact with the surface of the lead. The pressure then begins to rise, and the lead is squeezed into the annulus between the two nozzles, being forced out as a tube, and carrying the cable with it, though the latter really lies freely within the tube, and is not compressed. To ensure equal thickness of the lead sheath at all parts of the circumference, a baffle plate is supported over the nozzles at a height found by trial to give a correct result. As the leaden tube emerges from the cylinder, it is critically examined by a workman, who is enabled to see the whole circumference by holding a mirror beneath it. The cable is wound up on a drum driven through variable speed friction gearing by an electromotor; by this means perfect control of the winding is obtained. When half the lead within the cylinder is expended, the ram is lowered, a fresh supply of molten lead is run in from the melting furnace adjoining, and the process continued. In this way a perfectly continuous sheathing of lead can be laid on any length of cable, no matter how great. In order to regulate the temperature of the lead (which is judged by the pressure necessary to expel it) the cylinder is provided with a water jacket. This is a very important consideration, as if the lead is too soft or even liquid, it may be violently expelled from the cylinder, while if too hard, a higher pressure is required to force it out than it is desirable to employ. As a matter of fact, in spite of the enormous strength of the solid steel columns, and of the hydraulic cylinders, it is no rare event for one or other of these to be fractured; the reason of this, we understand, is believed to be the molecular fatigue of the steel.

The largest of these presses is capable of applying a sheath no less than 4 inches in diameter; on the other hand, it is possible and practicable to cover wires no larger than No. 16 S.W.G. overall. The telephone service cable used by the Post Office authorities, and the small telegraph leads with which they are replacing the gutta-percha-covered wires formerly employed, are but little above this size.

The press room is served by two single-motor electric travellers, which for speed and handiness give the greatest satisfaction. In this room also are furnaces for the final refining of the lead, which must be of the highest quality.

From the lead press room the cable drums are wheeled to the tank room. At each end of this is a deep tank of water, in which, after sealing the ends, the lead-covered cables are immersed while hot. The effect of this is to create a partial vacuum within the sheathing, so that if any crack or pinhole exists in the latter it is certain to be discovered by the influx of water. Here the cables are left for 24 hours, after which they are withdrawn from the water, the ends opened, and a test pressure applied at a pressure of 2,500 volts for low pressure cable, 10,000 volts for high pressure, and 20,000 volts for extra high pressures. There is no exception to the application of this high pressure test; *all* cables have to undergo it. At present the pressure is alternating, so that the actual pressure applied is about 40 per cent. higher than these figures; a direct current high pressure motor generator is about to be installed for D.C. tests.

The next process, if required, is the armouring. This is carried out in a large room containing a number of machines, three of which are seen in our illustration. Here the cable is coated with a thick tarry composition heated by steam pipes during application; next a serving of jute is applied on the hot composition; over this more tar, followed by either steel tape, laid in two layers breaking joint, or iron wires, as the case may be. The tape is preferred in most instances. Afterwards another layer of jute and composition is added, followed by whiting (to prevent stickiness), and the finished cable is wound on drums, ready for use. The machines are all driven by motors, two of which are seen in our view, covered with zinc boxing.



Armouring Machines.

A large part of this room is at present used as a cable store, but a portion of it is fitted up for testing purposes; a partition is to be erected down the middle of the room, and

the part so cut off will be equipped as a test room, the space at present devoted to this purpose being somewhat inadequate to cope with the rapidly increasing volume of business.

A part of the copper wire used in the works is manufactured on the spot. The copper is received in the form of pigs, weighing 1 cwt. each. These are heated in muffle furnaces by producer gas, and are "broken down" in heavy rolls, driven by a 700-H.P. engine of tandem compound type. The rolling mill is capable of turning out 100 tons per week of copper "rod," $\frac{3}{16}$th inch in diameter. At the time of our visit the engine was being overhauled and fitted with a new low pressure cylinder, so that the mill was idle; but we were informed that the spectacle afforded by it when in full working was both interesting and striking. The white-hot ingots are rapidly passed to and fro through the rolls, and as soon as they attain a sufficient length the leading end is whipped into roll after roll by skilful men, so that towards the conclusion of the process something like 1,000 feet of red-hot rod is passing through six or eight rolls in succession and being wound up on a swift at the same time. Meanwhile another ingot is being broken down in readiness to follow the first without loss of time. It is important that the whole operation of conversion from ingot to rod should be completed while the copper is still red-hot, so that it may be drawn without requiring reheating.

The coils or "strings" of copper thus formed are subsequently pickled in an acid bath and drawn down to wire on a number of benches, which are shown in one of our illustrations. These are fitted with wire-drawing dies and drums, of a total capacity of 50 tons per week. This plant is now being extended to bring the output up to 100 tons a week.

The wire-drawing plant is driven by shafting from the rolling mill engine. A truck load of "strings" is seen in the foreground in our illustration. After being drawn down to the required size, the coils of wire are passed slowly through a range of muffles, heated with gas, into a tank of water, by which the wire is softened ready for use in the manufacture of cable.

The segmental strip used for the outer layers of concentric cable is made out of round wire, passed between rolls to flatten it, and afterwards through a die to give it the exact shape required.

(*To be concluded.*)

ELECTRIC TRACTION NOTES.

(*Continued from page* 342.)

The Jungfrau Railway.—A *Financial News* correspondent at Zurich says:—

The Jungfrau Railway concern appears to be in a very critical situation, if the *Schweizer Handels Zeitung* is to believed. Since last winter the works have not advanced in the least, and have even been entirely suspended for the last few months. The working statements, as published from time to time, are, according to the above-mentioned paper, inaccurate. If the efforts to attract more capital do not turn out to be successful, the whole project (the cost of which is far heavier than put down in the estimates) is in great danger.

Norwich.—On a charge of placing a large piece of wood on the electric tramline, whereby a car laden with passengers had a narrow escape of derailing, a bus driver named Riches has been fined £5 and costs, or six weeks' imprisonment. The Bench expressed itself very strongly upon the grave character of such an offence.

South Lancashire.—The Radcliffe Council and the other interested authorities have received notification from the South Lancashire Tramways Company stating that they intend asking Parliament next session for powers to extend their electric tramways from Worsley, through Little Hulton, to Farnworth, Little Lever, Radcliffe, and Whitefield, nearly 10 miles. This is in addition to a 70-miles network of tramways which the company are about to lay down in South Lancashire.

Southampton.—The Borough Council, it is reported, will be asked at the next meeting to sanction a loan of approximately £50,000 for the purposes of the tramways extension. Various proposals are reported to be afoot for supplying motor car services to certain districts which, it is expected, will be important feeders of the tramcar traffic.

Sunderland.—In our description of this electric tramway system last week we mentioned that the British Thomson-Houston Company were the sub-contractors to Messrs. Dick, Kerr and Co. in connection with the equipment. This, however, was an error, as the B.T.H. Company were not connected with the work.

Sunderland.—A Birmingham paper says that dastardly attempts are repeatedly being made to wreck the Corporation electric tramways which were started here a fortnight ago. On two occasions iron slabs an inch thick have been laid across the lines after dusk, but on each occasion the driver timely detected the obstruction. The latest device has been to insert steel punchings within the groove of the rails. A town's reward of £20 and the constant vigilance of the detective force has so far failed to trace the culprit.

Surrey.—Schemes are being promoted for the purpose of constructing light railways in Surrey from Chobham to Woking, Send, Ripley, and West Horsley, and from Walton-on-Thames to Weybridge and Addlestone. Some of the places proposed to be served are several miles away from a railway station.

West Cumberland.—It is stated that a combination promoted by Messrs. Dick, Kerr & Co. propose to apply for a provisional order in next session of Parliament for an electric tramway from Whitehaven to Maryport, providing the local authorities support the project. The promoters are asking that a preliminary meeting should be held with representatives of the Corporations of Whitehaven and Workington, and of the Urban District of Maryport.

TELEGRAPH AND TELEPHONE NOTES.

The Alaskan Cable.—According to a statement appearing in the *Electrical World*, from a San Francisco source, it is reported that the steamer *Orizaba*, belonging to the Pacific Coast Steamship Company, has been chartered by the Government to take and lay the military cable which it is proposed shall connect St. Michaels, Unalaklik and Nome, in Alaska. The Kerite cable, which is now on its way west, is 200 miles in length and weighs a ton to the mile. The *Orizaba* will leave for the North with the cable about August 25th, and actual work will begin about the middle of September. The cable when laid will be under Government control. The primary object of this comparatively short stretch of cable is to put the mining camp at Cape Nome in communication with the rest of the world through a landline and cable system terminating at St. Michaels. From the extreme western end of the system of communication thus created, at Unalaklik, it is no great distance across the Behring Straits to a point on the Siberian or Kamtschatkan coast in communication with the Russian landlines across Siberia. It now seems likely that the northern line, under the pressure of the urgent need for communication, will be completed before any plan for connecting the Hawaiian Islands and China is put into effect. Mr. G. F. Porter, of the Brixey Kerite Company, is accompanying General Greely, of the United States Signal Service, on this work. The line will be equipped with sine-wave transmitters for automatic work, and will also have a Morse equipment for hand work. Current will be supplied by gas engine-driven generators.

Chinese Telegraphs.—The Eastern Extension, Australasia, and China Telegraph Company, Limited, notify that arrangements have been made for the early laying of a cable between Chefoo and Shanghai. This will provide submarine telegraphic communication (available for international traffic) entirely independent of the Chinese landlines, and without any addition to the existing tariffs. Reuter says that the ss. *Pender* left Shanghai on 29th inst to lay a cable between Wusung and Chefoo.

Glasgow Telephones.—The National Telephone Company are carrying out a number of improvements in their system at Glasgow, among which may be mentioned:—(1) Substituting twin wires or metallic circuits in place of the existing single wires on earth circuits. (2) Providing a message rate service on the metallic circuit principle at a low annual charge, with a special calling and clearing arrangement, charging a penny fee for every outward local call, but giving all inward calls free. (3) Introducing the party line system, whereby two or more persons or firms may share one metallic circuit line at a greatly reduced rental. The transfer from single to metallic circuit working will, it is expected, be completed in a few months.

Manchester Telephones.—The special committee *re* telephones of the City Council held another meeting last week relative to the inquiry as to the best means of improving the telephone service in the city. The committee have now been sitting some months, and for the whole of the time have been engaged in negotiations of one sort or another. To start with, they were committed to the production of some scheme, which either directly or indirectly will give a municipal service of telephones to the city. Three courses were open to them—(1) To endeavour to arrange terms for the purchase of the Manchester area of the National Telephone Company; or (2) to conclude an arrangement under which the Mutual Telephone Company would provide competition under approved conditions; or (3) to commence an entirely independent service directly under the auspices of the Corporation. According to the *Manchester Evening Chronicle* the first method was first tried, and during the past few months a number of interviews have been held with the representatives of the National Telephone Company. There never appeared very much prospect of these negotiations leading to any tangible result, but it was thought best to give them every possible chance of success. It may now be said that they have definitely failed, so that the first course is practically abandoned. Negotiations in relation to the second course are now proceeding, and Mr. Thompson, for the Mutual Company, had a long interview with the committee on 22nd inst.

Post Office Telegraphs.—A Parliamentary return of the revenue and expenditure of the Post Office gives the following figures relating to the telegraphs:—The total estimated receipts for 1899-1900 were £3,460,492, as compared with £3,260,145, and the total expenditure, including sites and buildings, telegraph extensions, superannuation and other non-effective charges, salaries and wages, and maintenance of the telegraph system, £3,748,930, as compared with £3,482,014 in the previous year. The deficit, therefore, on the telegraphs for the year was estimated at £288,438, as against £221,869. Deducting, however, the expenditure on sites and buildings and extensions, the deficit this year shows a reduction of £21,979.

South African Telegraphs.—The *Times* Cape correspondent reports that telegraphic communication has been restored with Johannesburg, Pretoria, and some other places in the south of the Transvaal.

Telegraphic Communication with the East Indies.—The *Board of Trade Journal* quotes the *Levant Herald* of August 9th as stating that the Sultan has ordered that the necessary measures be taken to establish direct telegraphic communication with the East Indies. Formerly communications were made through Fao, at the extremity of the Gulf of Bussorah, but this line has not been maintained, and despatches now go over the English and Russian cables through Persia. The project for the re-organisation of the telegraph line to the East Indies includes the establishment of one or two wires between Fáo and Bagdad having connection with the network of the capital by Aleppo on the one part and by Diarbékir on the other. The Administration of Posts and Telegraphs has taken steps in order to commence the work immediately. The estimated expenses vary from 30,000 to 40,000 Turkish pounds. The rates for messages will be less than those of foreign lines by 50 centimes per word in order to efficiently compete with them, and to divert messages to the Government line.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
South American:—		
Cayenne-Pinheiro	Oct. 11, 1899	
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
West Indies:—		
Mole St. Nicholas-Cape Haitien	March 6, 1900	
Latakia-Cyprus	June 20, 1899	
St. Louis (Senegal)-Bathurst	Aug. 25, 1900	
Tarifa-Tangier	Jan. 8, 1900	
Landlines:—		
Chinese:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *vía* Shanghai	June 16, 1900	
Tientsin-Niuchwang	June 18, 1900	
South American:—		
Communications with all offices of Columbia beyond Buenaventura	January 22, 1900	
Ecuador landlines	March 13, 1897	
Landlines south of Macahé (Brazil)	April 25, 1900	
Landlines south of Serena	July 30, 1900	
Siberian:—		
Blagowestschensk-Wladiwostock	Aug. 21, 1900	Aug. 22, 1900
Blagowestschensk-Khabarowsk	Aug. 27, 1900	Aug. 28, 1900
West Indies:—		
All Haytien landlines	Aug. 15, 1900	Aug. 19, 1900
Communication "*via* Hanekins" interrupted on Persian territory	Feb. 24, 1900	
Saigon-Bangkok	Aug. 14, 1900	

Wireless Telegraphy.—The *Daily Chronicle* has interviewed Mr. Allen, the secretary of the Wireless Telegraph Company, on the subject of Wireless Telegraphy in the British Navy. Among other things Mr. Allen imparted to him the information that the Admiralty had ordered the Marconi system to be installed on 32 British ships. The official test took place on Monday. Each apparatus has to be tried between Portsmouth and Portland, a distance of about 65 miles, and this is a severe test in consequence of the intervening hills of St. Alban's Head. There is also talk about fixing the system on certain land stations for communication with warships.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—August 25th. The Corporation invites tenders for steel poles, bases and brackets, for tramway equipment. See "Official Notices" August 10th.

Aberdeen.—August 28th. The Electric Lighting Committee wants tenders for a 12 months' supply of cables, meters, and house main fuse boxes. See "Official Notices" August 17th.

Aberdeen.—September 29th. The Electric Lighting Committee wants tenders for two 200-kw. direct coupled continuous current generators, and one 120-kw. balancing set; one 420-kw. direct coupled generating set. All Willans engines. See "Official Notices" August 24th.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jilles, St. Jilles.

Budapest.—October 15th. The Hungarian Minister of Commerce is prepared to receive tenders for the installation of two telephone exchanges, local and interurban, complete in all respects. See "Official Notices" August 3rd.

Cardiff.—August 31st. The Corporation wants tenders for sundry pipes, feed-water heater, &c., for the electricity works. See "Official Notices" August 17th.

Copenhagen.—September 19th. Tenders are wanted for two steam boilers for the electricity works. See "Official Notices" to-day.

Doncaster.—September 5th. The Corporation invites proposals for the conversion of existing gas fittings, and the supply of new fittings for lighting the Mansion House with electricity. See "Official Notices" to-day.

Doncaster.—September 5th. Tenders are invited by the Corporation for electric wiring and fittings for the Mansion House. See "Official Notices" to-day.

Dublin.—October 4th. The Electric Lighting Committee wants tenders for the supply and laying of mains and accessories. See "Official Notices" to-day.

Germany.—August 30th.—The municipal authorities of Dusseldorf are inviting tenders until the 30th inst. for the supply and erection of two 3-ton overhead electric travelling cranes and two 4-ton ditto. Particulars may be obtained for 2s from, and tenders are to be sent to, Die Oberbürgermeister, Stadtbaumt III Dusseldorf.

Germany.—September 10th.—The Hamburg Finance Deputation is inviting tenders for the supply and erection of two 30-ton electric cranes. Particulars may be obtained for 3s. from the Secretariat II. der Finanz Deputation (Rathhaus Ober-Erdgeschoss, Zimmer 429), and tenders marked 339 are to be sent to Die Finanz Deputation, Hamburg.

Greenock.—September 10th. The Police Board requires tenders for water-tube boilers, steam dynamos, boosters, switchboard, piping, &c., for electric traction. See "Official Notices" August 24th.

Hackney.—September 12th. The Electric Lighting Committee is wanting tenders for the supply of condensing plant, cooling apparatus, pipe work and valves, feed pumps, switchboard and boosters, arc lamps, meters, crane and workshop equipment. See "Official Notices" August 17th.

Hammersmith.—September 12th. The Vestry wants tenders for two single-phase alternate current motors coupled to two centrifugal pumps. See "Official Notices" August 24th.

Hampstead.—September 27th. The Vestry invites tenders for eight marine boilers, piping, feed-heater or detartariser, fuel economiser, and tanks. See "Official Notices" August 24th.

Hull.—September 27th. The Corporation wants tenders for certain steam and water pipes, pump, water softener, &c., for electricity works. See "Official Notes" August 24th.

London.—September 24th. The L.C.C. is inviting tenders for the supply of mains for the installation for the Victoria Embankment and Westminster Bridge. See "Official Notices" to-day.

London County Council.—September 22nd. Tenders are wanted for boilers, engines, dynamos, &c., at the Horton Estate, Epsom, Surrey. See "Official Notices" August 10th.

Luton.—September 14th. The Town Council invites tenders for watt-hour and demand meters. See "Official Notices" August 3rd.

Mexborough.—September 15th. The Council wants tenders for a Lancashire boiler, two 50-kw. dynamos, balancer and boosters, feed heater, and pump, switchboard, battery, mains, crane, and adapting the street gas lamps for electric lighting. See "Official Notices" to-day.

Nelson.—September 8th. The Corporation wants tenders for a 200-kw. steam dynamo. Specifications from Mr. Allen, engineer at the gas works. £2 2s. deposit.

Newcastle-on-Tyne.—August 31st. Tenders are wanted by the New Tramways Committee for conduits and holes for poles. Specifications (£3 3s. deposit) from the consulting engineer, Mr. C. Hopkinson, London and Manchester.

Perth.—September 15th. The Commissioners want tenders for direct current meters and cut-outs. See "Official Notices" to-day.

Plumstead.—September 19th. The Vestry wants tenders for boilers, refuse destructor, steam fittings, economiser; steam piping, pumps, &c., &c.; steam generators—two 300-i.h.p.; two 150-i.h.p.; and one 100-i.h.p.; condensing plant, cooling tower, &c.; switchboard; battery; traveller; mains, meters, arc lamps and posts, &c. See "Official Notices" August 10th.

Portsmouth.—September 4th. The Corporation wants tenders for the complete equipment of the tramway power station. See "Official Notices" August 3rd.

Portsmouth.—September 10th. Tenders are wanted for electric light fitting work at the new Drill Hall. See "Official Notices" to-day.

Preston.—September 10th. The Guardians want tenders for an electric light installation at Fullwood Workhouse. See "Official Notices" August 24th.

Salford.—September 3rd. The Corporation wants tenders for a lighting switchboard, traction ditto, and balancing transformers. See "Official Notices" August 10th.

Salford.—October 2nd. The Cleansing Committee of the Corporation wants tenders for a two or three-cell refuse destructor. Also for a six-cell destructor on the forced or accelerated draught principle, together with necessary boilers, &c. See two "Official Notices" to-day.

Southampton.—September 10th. The Harbour Board wants tenders for a 30-cwt. portable electric crane. Specification from Mr. Bowyer, Harbour Offices, Town Key. Deposit £5.

Southampton.—September 11th. The Guardians want an electric lighting plant erected at the new workhouse infirmary, Shirley Warren. Particulars from Mr. J. Aldridge, 9, Victoria Street, S.W.

Stockport.—August 31st. The Tramways Committee wants tenders for 20 double-deck tramcars with electrical equipments. See "Official Notices" July 13th.

Sunderland.—September 21st. The Corporation wants tenders for triple expansion high speed, direct current dynamos, Lancashire boilers, feed pumps. See "Official Notices" to-day.

Walthamstow.—September 25th. The Council is inviting tenders for gas plant, gas engines, dynamos, switchboards, boosters, balancer, and measuring instruments. See "Official Notices" to-day.

Whitby.—September 3rd. The Council wants tenders for the supply of two water-tube boilers, pumps, condensers, pipes, &c.; two steam dynamos, balancer, and boosters; switchboard and connections; battery; travelling crane; cables, arc lamps, &c. See "Official Notices" August 10th.

Worthing.—September 3rd. The Corporation wants tenders for three 96-kw. steam dynamos, two marine boilers, steam and other piping and condensing plant, manhole covers, arc lamps and posts, stoneware casings, cable work, battery, balancing transformers and motor-generators, economiser, and 5-ton traveller. See "Official Notices" August 17th.

Wrexham.—Tenders are wanted for a dynamo and three electric motors, &c., to drive centrifugal pumps. See our advertisement pages to-day.

CLOSED.

Barnes.—The Council has accepted the tender of Messrs. Babcock & Wilcox for condensing plant, pumps, piping, &c., at £2,239. The other tenderers were:—

Alley & MacLellan	£2,480
Aiton & Co.	2,596
J. Simpson & Co.	2,800
Cole, Marchent & Morley	2,860

For the overhead travelling crane there were three tenders submitted as follow:—

John Whitley & Co.	£420
Jas. Carrick & Son	265
Chatteris Engineering Works Company (accepted)	264

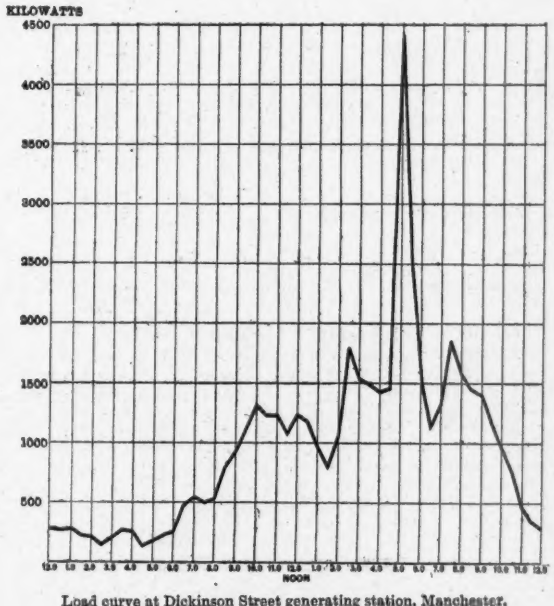
Grimsby.—The Grimsby Corporation have accepted the tender of Messrs. Crowther & Co., of Manchester, for the wiring of their new electricity works in Doughty Road, Grimsby.

Portsmouth.—The Town Council has resolved that a 500-kw. alternator be purchased from Messrs. Parsons & Co. for £5,300, it being agreed that Messrs. Parsons shall take back the old alternator and allow £1,200 for it.

NOTES.

The Bolton Corporation Electrical Engineership.—The members of the Electricity and Tramways Committees of the Bolton Town Council met on Thursday afternoon last week to consider what should be done with regard to the appointment of an electrical engineer in succession to Mr. Arthur Ellis, who goes to Cardiff. It will be remembered that at a previous meeting, after a sitting extending over three hours, the Joint Committee decided to offer the position to Mr. H. F. Street, of Halifax, and that this gentleman, on being informed of his selection, said he would consider the matter. It was understood that Mr. Street would give a definite reply by Monday, August 20th, but no communication had been received from him up to the 23rd. The Joint Committee therefore resolved to appoint Mr. Arthur A. Day, chief assistant-engineer at the Manchester Corporation Electricity Works. Mr. Day, who was one of the four candidates selected to appear before the Joint Committee, will have a commencing salary of £500, with a yearly increase of £50 until £750 is reached. He is 35 years of age, and was educated at King's College, London. On completing his education, he acted as assistant to the late Prof. Jenkins, F.R.S., afterwards joining a London firm of electrical engineers. Prior to going to Manchester he drew up the scheme for lighting the borough of Godalming, in Surrey, by electricity. Mr. Arthur Ellis concludes his duties at Bolton as from August 31st. There is a proposal before the Electricity Committee at Bolton to grant him an honorarium of £200 for special services rendered. Mr. Day visited Bolton on Friday, and was shown over the works. He has intimated to the Committee that he will take up duty about the middle of September. In regard to Mr. Street, it is now reported that, following upon his interview with the Bolton Committee and selection by them, he communicated the result to the Gasworks and Electricity Committee of the Halifax Corporation, with the intimation that he would be content to stay with them if his salary was advanced from £400 to £500 per annum. A resolution to this effect was carried in committee, but defeated at the Council meeting by 18 votes to 17. A communication from Mr. Street was received by the Bolton Town Clerk on Friday declining the appointment for Bolton. This, it will be observed, was subsequent to the appointment of Mr. Day to the position.

A Thunderstorm Load Curve.—On Tuesday, the 21st inst., Manchester was visited by a very heavy thunderstorm. Mr. C. H. Wordingham, the city electrical engineer, has kindly sent us a load curve for that day, as it cannot fail to be of interest to our readers. Mr. Wordingham adds: "I question whether the suddenness and magnitude of the demand is often surpassed in any city."



Load curve at Dickinson Street generating station, Manchester, Tuesday, August 21st, 1900.

Fog Load Curve.

The Water-Tube Boilers Committee.—The Committee on Water-Tube Boilers in the Navy has now been completed by the selection of Mr. John Inglis, LL.D., head of the firm of Messrs. A. and J. Inglis, engineers and shipbuilders, Pointhouse, Glasgow, late president of the Institution of Engineers and Shipbuilders in Scotland, and Vice-President of the Institution of Naval Architects.

The Jubilee (?) of Submarine Telegraphy.—Tuesday, August 28th, was the fiftieth anniversary of the establishment of communication by means of submarine telegraph cables between France and England, and it is only in the nature of things that Englishmen who owe so much to the submarine cable, should once more cherish the memories of those who, in those days of almost overwhelming difficulty, pioneered the scheme to a successful issue. The name of the Bretts has been receiving some of its merited honours from the pen of the newspaper man during the past week, for the papers have made fitting references to the jubilee. If there be living to-day any of those who were wont to hinder the Bretts and their associates in the great work, by their scepticism and ill-foreboding, the events of the past 50 years in submarine telegraphy must read to them more or less like a great romance. Little did they, or even the pioneers themselves, imagine that within 50 years a great all-British Pacific cable scheme would be on the verge of accomplishment. Had it not been for unconscionable delays and monopolistic time-consuming obstruction, the Pacific cable might have been completed in time to celebrate the jubilee of submarine telegraphy.

In a letter to the *Times* regarding its article on the jubilee, Mr. Willoughby S. Smith, of the Telegraph Construction and Maintenance Company, writes as follows :—

Great skill and ingenuity were necessary to overcome the constructional difficulties, and the names of others in this connection could, with justice, be added to those you mention, and I trust that some day a suitable memorial may be raised to the energy and ability of the pioneers to whom this nation is so largely indebted. The original machinery used in the manufacture of the Dover to Cape Grisnez experimental line is still carefully preserved at this company's gutta-percha works, Wharf Road, City Road.

Electrical Engineers in Paris.—In our last issue we referred in an article to the discussion in which English and American electrical engineers engaged while at Paris. It may now be of interest to briefly mention the other items which went to make up the very full programme of arrangements during the stay there. The party left London on Wednesday, August 15th, and on the following day held its first meeting in the American Pavilion, and discussed the subject to which extended reference was made in our last issue. The speakers were Mr. Ferranti, Sir W. H. Preece, Messrs. A. E. Kennelly, Corda, Crocker, Mordey, Arnold, Ward Leonard, and Profs. Ayrton, and S. P. Thompson. The discussion was followed by announcements, and a short description of the leading exhibits by Mons. Hospitalier, Major-General Webber, Messrs. Gavey and Carl Hering. It was but fitting that a formal vote of thanks should then be accorded to the American Commissioner for the use of the room, for the whole pavilion was closed to the public during the morning while the conference was in progress. Prof. Perry and Mr. Carl Hering acted jointly as chairman, Prof. Perry being spokesman. It should be mentioned that the meeting opened by short addresses of welcome in English, French, and German by Mr. Hering, and a short address by M. Mascart. In the afternoon of the same day, visits in group parties were paid to the Exhibition, and the chief exhibits of interest were located. On Friday, August 17th, a visit was paid to the Westinghouse central station, and the moving platform, and afterwards to the installation of the Western Railway of France, at Moulineaux, Champs de Mars, &c. The Congress of Electrical Engineers was duly opened the following morning, and on Monday, 19th inst., the various sections settled down to work. In the afternoon the reception by the American Institute members took place in the U.S. Pavilion, and in the evening Prince Roland Bonaparte held a reception of members of the Congress. On Tuesday, 20th inst., the members visited Chantilly, and the following day the British Institution members held a reception in the British Royal Pavilion.

South-Western Polytechnic, Chelsea.—Mr. William Henry Eccles, B.Sc., and Mr. Charles Frederick Smith, Whitworth Scholar, have been respectively appointed to the posts of Senior Demonstrator of Physics and Senior Demonstrator of Electrical Engineering at the South-Western Polytechnic.

Open v. Enclosed Arcs.—"Open Arc" writes to the *North British Daily Mail* on this question, as follows :—

I wish to draw attention to a matter that hitherto has not been dealt with as it deserves. In many shops in Glasgow there are enclosed arc lamps used. These, when burning two in series on 250 volts, waste about one-third of energy supplied. The user, therefore, of these lamps is paying one-third of his electric light bill for energy which is merely dissipated in a resistance. This resistance, by the way, is dangerous used in a case like above, and I think the attention of insurance companies should be directed to them. Having to dissipate so much energy, they are generally almost red hot. The light of these lamps is also very poor. This is not owing to the absorption of light in double globes used so much as to the fact that since the lamp is only trimmed once in 100 hours or so the inner globe is covered with a deposit of ash from arc long before it is time to recarbon them. The makers of enclosed arc lamps claim a saving in carbons, but I don't see much good in this if the consumer has to pay through the nose for energy for his resistance, and also provide inner globes, which are continually breaking. In view of the winter coming on, the above should meet with the consideration of intending users of the electric light in this form. I think this system of using enclosed arc lamps is a retrograde movement, but should be glad to hear the views of electrical men, and experience of any users of these.

Conduit v. Trolley for London.—We alluded last week to Mr. Arthur Warren's contention in the *Westminster Gazette* in favour of the conduit system of electric tramways for London. Unconsciously Mr. Warren gives splendid testimony to the advantages of the overhead system for our great city. "Then snow," says the British Westinghouse expert, "as an obstacle to electric traction, is unknown in London. In Boston, on the other hand, where the overhead trolley system is used, the heavy snowfalls have broken the overhead wires and damaged the entire electric traction system of the city." Now if this has any meaning, it is to the effect that the overhead trolley is the right thing for London, and that Boston and also New York, with its 3 to 4 feet depth of snow in a single day, would both be only too glad to employ the trolley but for the adverse climatic conditions which do not obtain in England's metropolis. We commend this to the notice of the members of the L.C.C.

Appointments.—A Glasgow newspaper says that there has been a good deal of canvassing and competition for the post of mechanical engineer for the Port Dundas electric tramway station (£250 per annum). It adds that there were from 200 to 300 applicants, and a short leet is being drawn up.

Mr. E. Stanley Harpham has been appointed to the position of assistant distributing engineer to the Charing Cross and City Company. Mr. Harpham was for some years with Messrs. Easton, Anderson & Goolden as a pupil and in charge of the dynamo testing department. Subsequently he was with the Charing Cross and Strand Company, whose employ he left two years later to join the staff of the Callender Cable Company, acting as resident engineer for them at Greenock, Swansea, and elsewhere. He has now rejoined his old company under its new title.

Appointments Vacant.—An assistant electrical engineer is wanted by the Belfast Corporation at £120 per annum. A resident electrical engineer is wanted by the Partick Commisioners. The Sheffield Corporation wants a superintendent for the electricity meter department, jointers, and an engine driver. An overhead wireman is wanted for traction work in Lancashire. See "Official Notices."

Erratum.—In Mr. Bathurst's article on the "Generating System of Prague," ELECTRICAL REVIEW, August 17th, p. 250, in line 32, the word *reacted* should read *reached*.

Lectures.—On 20th inst. a programme of lectures before the University Extension students at Cambridge was opened with a discourse on the "Progress of Electricity" by Prof. J. J. Thomson.

Economies of Superheated Steam in the Steam Turbine.—The *Scientific American* says that the excellent results obtained with the best types of steam turbines are due in no small measure to the fact that they are not subjected to the cylinder condensation which is a fruitful source of loss in the ordinary reciprocating engine and the forms of rotary engines not of the turbine type. When the steam turbine is steadily at work the interior surfaces are at virtually constant temperature, and, for this reason, it might be supposed that the only gain which would result from the use of superheated steam would be that due to the increase of thermo-dynamic efficiency corresponding to the wider range of temperature. It seems, however, that in the course of investigations carried out at Sibley College, it has been found that there is an actual gain of about 1 per cent. for every 3° F. of superheat, which is accompanied by an increase in the capacity of the turbine of about 100 per cent. for 37° F. of superheat. It is considered that the causes of each of these gains from superheating are identical, and are due to the removal of the friction which is present when saturated steam is passing through the turbine. In the latter case there is a retardation of the flow of the steam due to moisture in the form of drops and mist, the moisture clinging to the walls of the steam passages within the turbine. This explanation is corroborated by the fact that the gain, as far as the experiments have gone, is about proportional to the amount of superheating. Sibley College is to be congratulated on this, the latest of many valuable truths which have been disclosed as the result of the careful investigations carried on under Prof. Thurston by this famous engineering school.

Electrical Installation at Bruges.—A New York exchange says that in the construction of the Port of Bruges, all the machinery and apparatus is operated electrically, the power being furnished by a central station containing three Willans compound engines of 500 H.P., driving three dynamos at 500 volts. The electric distribution covers the whole extent of the future port, and 30 motors are used for the operation of the different machines, including four brick-making machines, circular and band saws, the machines of the boiler shop, those of the central repair shop, and the machines used in the construction, which include three large pumps, five mortar mixers, a stone breaker, the windlass of the excavating conveyer, pile drivers, three derrick cranes and eight smaller cranes, besides numerous other machines. When the port is finished, current will be supplied for the motors of the rolling gates of the locks and for the revolving bridges. The four brick-making machines have a mean daily capacity of 160,000, and have reached 200,000; each is operated independently by a motor. The boiler shop carries on heavy work, such as the envelopes for great blocks of *béton* of 3,000 tons, for each of which 5,000 tons of plate and corner pieces are necessary. For the construction of the jetty, over 2,800 tons of steel will be used, in the form of uprights, timbers and cross pieces; for the lock gates 700 tons of steel are used.

Rathmines Electricity Works.—To-day the Lord-Lieutenant and the Countess Cadogan are to perform the inaugural ceremony at the Rathmines municipal electricity works.

Personal.—The *Standard* says that Mr. W. E. L. Gaine, the general manager of the National Telephone Company, "has left in the *Oceanic* for a few months' tour to observe the latest improvements in telephonic inventions."

Marriage.—Mr. J. H. Heathman, of telescopic ladder fame, was married yesterday, August 30th, to Miss Pattie Klein, at St. James's Church, Muswell Rise.

NEW COMPANIES REGISTERED.

Works Dismantling Company, Limited (66,964).—This company was registered on August 14th, with a capital of £3,000 in £1 shares, to carry on the business of machinery and metal merchants and dismantlers, founders, electricians, electrical and mechanical engineers, gas motor car manufacturers, manufacturers of insulators, conductors, and all electrical apparatus and appliances, &c. The first subscribers (each with one share) are:—G. B. Saunders, 39, Devonshire Place, Newcastle-on-Tyne, merchant; H. Todd, 2, Kensington Terrace, South Shields, merchant; W. G. Robson, 22, Kingsley Terrace, Newcastle-on-Tyne, solicitor; Mrs. E. Saunders, 39, Devonshire Place, Newcastle-on-Tyne; Mrs. A. B. Todd, 2, Kensington Terrace, Newcastle-on-Tyne; S. B. Saunders, 7, Pattenden Road, Catford, S.E.; and H. S. Arnett, 7, Gordon Square, Whitley Bay, merchant. The number of directors is not to be less than two nor more than five; the first are G. B. Saunders (chairman), H. Todd, S. B. Saunders, and W. G. Robson; qualification, £100.

Mordey-Fricker Electricity Meter Company, Limited (66,952).—This company was registered on August 13th with a capital of £20,000 in £1 shares, to acquire the inventions of W. M. Mordey and G. C. Fricker, relating to improvements in electricity meters, and to carry on the business of electric meter manufacturers, electricians, &c. The first subscribers (each with one share) are:—J. Atherton, 11, Charing Cross Road, W.C., manufacturer; J. B. Atherton, Manhattan, Gateacre, Liverpool, manufacturer; W. M. M. Forwood, 15, Union Court, Liverpool, solicitor; H. J. Russell, 30, Brighton Street, Seacombe, Cheshire, bookkeeper; W. M. Mordey, 82, Victoria Street, Westminster, electrical engineer; G. C. Fricker, 149, Fleet Street, E.C., electrical engineer; and A. E. Haptie, 5, Durham Road, Seaforth, near Liverpool, manager. The number of directors is not to be less than two nor more than seven; the first are Jacob Atherton, George Atherton, George H. Nisbett and Guy C. Fricker.

Finchley Electric Light Company, Limited (67,030).—This company was registered on August 22nd, with a capital of £3,000 in £1 shares, to carry on at Finchley or elsewhere the business of an electric light company in all its branches, and in particular to acquire from M. W. Woods the exclusive right of supplying electric light and power on the Finchley Manor Estate, granted to the said M. W. Woods by Messrs. Macer & Mallett. The first subscribers (each with one share) are:—C. H. Cribb, 130, Shaftesbury Avenue, W., analytical and consulting chemist; L. Bradley, 93, Hatton Garden, E.C., electrical engineer; M. W. Woods, 2, Gray's Inn Road, W.C., electrical engineer; A. W. Marshall, 180, Loughborough Road, S.W., electrical engineer; A. W. Sclater, 182, Oxford Street, W., electrical engineer; W. A. Hogarth, 29, Devonshire Chambers, E.C., clerk; and W. R. Estall, 49, Lansdowne Gardens, Clapham, S.W., clerk. The number of directors is not to be more than five. M. W. Woods is a permanent director. Qualification, 100 shares.

Aberdare Electric Lighting Company, Limited (66,037).—This company was registered on August 23rd, with a capital of £2,000 in £1 shares, to carry on the business of an electric light company in all its branches. The first subscribers are:—J. W. Evans, Aberdare, solicitor, 50 shares; H. D. W. Lewis, Prudential Buildings, St. Mary Street, Cardiff, engineer, 50 shares; J. Howell, Greentull, Aberaman, auctioneer, 50 shares; J. H. Powell, London House, Aberaman, draper, 50 shares; A. S. Pleace, 67, Monk Street, Aberdare, brewer, 50 shares; G. George, J.P., The Laurels, Aberdare, valuer, 10 shares; J. H. James, Brynhyfryd, Aberdare, auctioneer, 20 shares; F. W. Mander, Glanynys, Aberdare, merchant, 10 shares; and C. C. McCall, 38, Cowbridge Road, Cardiff, surgeon, 50 shares. The number of directors is not to be less than three nor more than seven; the first are to be nominated by the above subscribers. Registered office, Bank Chambers, Aberdare, Glamorgan.

Union Cable Company, Limited (67,054).—This company was registered on August 24th, with a capital of £25,000 in £1 shares, to carry on the business of submarine and other cable manufacturers, suppliers of electricity, electrical and general engineers, rope makers, wire drawers, metal workers, shipbuilders, machinists, telegraph and telephone constructors, india-rubber manufacturers and merchants, &c. The first subscribers (each with one share) are:—E. E. O. Polland, 39, Bedford Place, London, engineer; A. Wilson, Elder Cottage, Maybank Road, South Woodford, Essex, clerk; F. H. Miller, 31, Paulet Road, Brixton, S.W., clerk; E. A. Redder, 29, Mincing Lane, E.C., solicitor; G. Runge, 49, Eastcheap, E.C., clerk; J. V. Varela, 33, Norfolk Road, Seven Kings, Essex, clerk; and R. W. Cawse, 118, Allison Road, Harringay, clerk. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first qualification, 250 shares.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Power Storage Company, Limited (30,313).—This company's annual return was filed on August 4th, when 66 founders' and 18,592 ordinary shares were taken up out of a nominal capital of £100,500 in 100 founders' and 20,000 ordinary shares of £5 each. £5 has been called up on each of the founders' shares, and £4 on each of 3,132 ordinary shares, resulting in the receipt of £12,808, in addition to which £474 5s. 1d. has been paid on four founders' and 405 ordinary shares forfeited. £50 remains in arrears. 15,460 shares are considered as fully paid.

British Aluminium Company, Limited (41,104).—This company's annual return was filed on June 16th, when 20,000 7 per cent. preference and 10,000 ordinary shares were taken up out of a nominal capital of £400,000 in 20,000 7 per cent. preference, 10,000 ordinary, and 10,000 6 per cent. preference shares of £10 each; £10 has been called up and paid on each of 16,770 7 per cent. preference and 8 ordinary shares; 13,222 shares are considered as fully paid. The capital has been recently increased from £300,000 to £400,000 by the creation of 10,000 6 per cent. preference shares.

Callender's Cable and Construction Company, Limited (48,915).—This company's annual return was filed on June 25th, when 30,000 ordinary and 33,420 preference shares were taken up out of a nominal capital of £400,000 in 40,000 ordinary and 40,000 preference shares of £5 each. £5 has been called up on each of 10,000 ordinary and 33,420 preference, resulting in the receipt of £154,983 10s. £62,116 10s. remains in arrear. 20,000 ordinary shares are considered as fully paid.

Edison & Swan United Electric Light Company, Limited (18,984).—This company's annual return was filed on August 17th, when 116,400 "A" and 23,564 "B" shares were taken up out of a nominal capital of £1,000,000 in 150,000 "A" and 50,000 "B" shares of £5 each; 10s. per share has been called up on 89,261 "A," resulting in the receipt of £44,630 10s.; £3 per share is considered as paid on 10,000 "A," £2 10s. on 89,261 "A," and £5 per share on 17,139 "A" and 23,564 "B"—total £456,667 10s.

British Thomson-Houston Company, Limited (47,982).—This company's annual return was filed on August 13th, when the entire capital of £400,000 in £10 shares had been taken up; £10 per share has been called up on 16,531, and £3 10s. per share on 16,000 shares, resulting in the receipt of £221,310; £74,690 is considered as paid on 7,469 shares.

Calcutta Tramways Company, Limited (14,764).—This company's annual return was filed on August 15th, when 34,440 shares were taken up out of a nominal capital of £350,000 in £10 shares. The full amount has been called up or credited as paid on each share. £159,300 has been paid and £185,100 is considered as paid.

Greenwood & Batley, Limited (27,098).—This company's annual return was filed on August 3rd, when 11,066 preference and 18,052 ordinary shares were taken up out of a nominal capital of £400,000 in 14,000 preference and 26,000 ordinary shares of £10 each. £10 has been called up on each of 6,934 preference and 12,134 ordinary, and £3 on each of 1,466 preference and 1,252 ordinary shares, resulting in the receipt of £198,834. £73,320 is considered as paid on 2,666 preference and 4,666 ordinary shares.

British Continental Electricity Company, Limited (51,080).—This company's annual return was filed on August 14th, when 984 preference and 807 ordinary shares were taken up out of a nominal capital of £20,000 in 1,000 preference and 1,000 ordinary shares of £10 each. £10 has been called up on each of 984 preference and 806 ordinary shares, and £9 on one ordinary share, resulting in the receipt of £17,983. £16 remains in arrears. 210 preference and 150 ordinary shares are considered as fully paid.

Electric Construction Company, Limited (39,293).—This company's annual return was filed on August 16th, when 112,100 ordinary and 25,000 preference shares were taken up out of a nominal capital of £400,000 in 150,000 ordinary and 50,000 preference shares of £2 each. £2 has been called up on each of 2,100 ordinary and 11,855 preference shares, resulting in the receipt of £27,910. 110,000 ordinary and 13,145 preference shares are considered as fully paid.

Globe Telegraph and Trust Company, Limited (7,465).—This company's annual return was filed on August 17th, when 180,042 preference and 180,227 ordinary shares were taken up out of a nominal capital of £5,000,000 in £10 shares (250,000 preference). £3,602,690 has been paid.

SUPPLY STATION ACCOUNTS.

Manchester Corporation Electricity Accounts.

The accounts for last year of the electricity supply undertaking of the Manchester Corporation show that the extension and increase of business are proceeding at a rapid rate. Work on the Bloom Street generating station is being pushed forward to meet the increasing demand for supply, and to provide the necessary power for traction. Workshops and cable stores are being erected at the Polygon, Ardwick, and plans have been approved for the equipment of a part of the new Stuart Street generating station. Considerable progress has been made in laying mains in the districts of Withington, Moss Side, and Levenshulme, while supply has been available in portions of Moss Side since December last (the revenue therefrom being £196), and in Withington since February last (where some £78 worth of energy had been sold).

The progress in the business is indicated by the following summary:—

GENERAL STATEMENT.

	1898.	1899.	Increase.
Total capital expenditure ...	£493,716	**£641,822**	£148,106
Number of units sold	4,773,247	**6,355,872**	1,582,625
Maximum load in KW.	4,246	**5,607**	1,361
Gross revenue	£71,453	**£85,832**	£14,379
Gross expenditure...	£30,518	**£19,439**	£18,921
Gross profit	£40,935	**£36,393**	−£4,542
Average price per unit sold ...	3·48d.	**3·23d.**	−·25d.

In the report the total length of conductors laid is given as 193,645 yards, equal to 110 miles odd, while 4,523 meters were in use at the end of the last financial year, measuring the supply to 3,240 consumers. The number of public arc lamps still remains at 26. The motors connected number 500, representing no less than 2,050 H.P., while there were 237,145 lamps of 8-C.P., and 2,139 arcs supplied from the mains.

Notwithstanding the increased price of fuel, a reduction in the rate of charge for energy was made in September last, bringing the charge to long-hour consumers down from 1½d. to 1¼d. per unit. Coupled with other things, this has caused the receipts per unit from sale of energy to fall ¼d., and the figure now stands at the moderate figure of 3¼d. In March of last year the charge for hire of meters was discontinued, which has led to a drop of $\frac{1}{10}$d., as is shown in the—

REVENUE STATEMENT.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£69,182	3·48d.	**£85,544**	3·23d.	−·25d.
Meter rents, &c.	2,240	·11d.	**184**	·01d.	−·10d.
Supply of lamps, &c.	...	...	...	...	...
Sundry fees	31	...	**104**	·00d.	...
Gross revenue ...	£71,453	3·59d.	**£85,832**	3·24d.	−·35d.

In the costs the important changes are in "repairs" and "rent, rates, &c." Over the latter the engineer has very little control. The former had to bear the expense of renewing a considerable length of main which has proved defective, and for the same purpose £12,460 were taken from the Renewals Account. The accident at Dickinson Street Station in September last wrecked two 400-H.P. sets, and the reserve fund supplied £7,070 on account of this breakdown.

COST OF PRODUCTION.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£8,251	·41d.	£10,376	**·39d.**	−·02d.
Oil, waste, water and engine room stores.	3,305	·17d.	3,883	**·15d.**	−·02d.
Salaries and wages incurred in generation and distribution.	4,383	·22d.	6,353	**·24d.**	+·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	6,113	·31d.	14,176	**·53d.**	+·22d.
Works costs ...	£22,052	1·11d.	£34,788	**1·31d.**	+·20d.
Rent, rates and taxes ..	2,383	·12d.	6,516	**·25d.**	+·13d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	3,653	·18d.	4,856	**·19d.**	+·01d.
General establishment charges, stationery and printing, law charges and insurance	2,430	·12d.	2,656	**·10d.**	−·02d.
Other expenses...	...	...	623	**·02d.**	+·02d.
Total costs ...	£30,518	1·53d.	£49,439	**1·87d.**	+·34d.

Owing to the incidence of costs and lessened receipts per unit, the gross profit has slightly suffered, and the whole of the net profit has been appropriated to the "City Fund in aid of rates."

PROFIT STATEMENT.

	1898.	1899.
Interest on loans	£10,572	£14,265
Sinking fund for repayments	10,377	12,935
Net profit carried to credit of rates	12,000	9,193
,, ,, reserve fund and suspense account	7,986	...
Gross profit	£40,935	£36,393

Burton-upon-Trent Corporation Electricity Accounts.

The position of the electricity supply undertaking, which at Burton is combined with the gas department, is considerably improved, and Mr. Ramsden must be congratulated on having practically got this branch of his works out of the mire. But the solicitude for the gas department is great. He is really anxious about the gasworks, and to show that the progress of the electric lighting department has not acted detrimentally upon the gas department, he states that the profits of the latter are £6,521, as compared with £6,105 for the previous year, notwithstanding that he has had to pay considerably more for coal. Surely Mr. Ramsden is quite aware that increased electric lighting has always been found to push up the gas sales (at least for several years from the start) and that better lighting of the main thoroughfares invariably calls for more or higher C.P. gas burners in the side streets.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£31,852	£40,474	£8,622
Number of units sold	118,445	154,210	35,845
Number of lamps connected ...	9,586	11,890	2,304
Maximum load in KW.	169	198	29
Gross revenue	£2,851	£3,732	£881
Gross expenditure	£1,729	£1,698	−£31
Gross profit	£1,122	£2,034	£912
Average price per unit sold ...	5·58d.	5·45d.	− ·13d.

The revenue account shows a small fall in the receipts per unit sold for energy (about ⅛d.) and a trivial alteration under "meter rents," but these are swamped by the appearance of a revenue item of "sales of fittings," which brought in £109, and leaves the total receipts at just over the figure per unit for 1898.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Sale of energy	£2,752	5·58d.	£3,503	5·45d.	− ·13d.
Meter rents, &c...	99	·20d.	120	·19d	− ·01d.
Supply of fittings, &c... ..	...	...	109	·17d.	+ ·17d.
Sundry fees	...	...	...	...	...
Gross revenue ...	£2,851	5·78d.	£3,732	5·81d.	+ ·03d.

It is when we come to the costs that we see how the position has been altered. Notwithstanding an output of 35,845 units more than in 1898, the gross total costs are less by £31 than they were in that year. For the small output the costs are decidedly good. Coal is phenomenally low, and the gross figure has actually fallen, but the gas works no doubt assist this item. The reductions in "wages" and in "repairs" are marked, and in the latter item the gross expenditure has been reduced. Total costs at 2¾d. are very much better than previous years' records had led one to expect.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit	Increase.
Coal	£191	·39d.	£158	·25d.	− ·14d.
Oil, waste, water and engine room stores.	78	·16d.	74	·11d.	− ·05d.
Salaries and wages incurred in generation and distribution	969	1·96d.	1,009	1·57d.	− ·39d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	213	·43d.	152	·24d.	− ·19d.
Works costs	£1,451	2·94d.	£1,393	2·17d.	− ·77d.
Rent, rates and taxes ..	77	·16d.	83	·13d.	− ·03d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	130	·26d.	130	·20d.	− ·06d.
General establishment charges, stationery and printing, law charges and insurance.	71	·14d.	92	·14d.	− ·00d.
Other expenses	...	...	...	...	...
Total costs ...	£1,729	3·50d.	£1,698	2·64d.	− ·86d.

The financial charges have been augmented by £147. To meet this and the loss of £770 in 1898, would require £917. As the costs have fallen £31, the whole of the extra revenue appears as extra gross profit, and amounts to £881. These sums taken together provide £912, or just £5 less than is necessary to pay all charges. This small sum therefore appears as deficit for 1899.

Profit Statement.

	1898.	1899.
Interest on loans	£900	£1,047
Sinking fund for repayments	992	992
Net profit (being deficit)..	−770	−5
Gross profit	£1,122	£2,034

CITY NOTES.

Johnson-Lundell Electric Traction Company.

The following report has been furnished us by the company:—The first general meeting of the Johnson-Lundell Electric Traction Company, Limited, was held at the offices of the company, Soho Square, London, on 16th inst., under the presidency of Mr. Leonard W. Holmes. The chairman drew attention to the fact that they had gone to allotment, and that the capital was entirely guaranteed by their own friends, though the public did not come in very strongly. The board of directors was selected from men of business capacity, Mr. Johnson, for example, having been the associate of Edison in the early days, and been engaged in electric traction in America since its inception. As chairman of the company, he was perfectly satisfied with the property they had acquired, and he had every reason to believe they would not regret the purchase they had made. They were at present in the market with their new dynamo, of which the licensees had already sold several, and the motor was being pushed forward in America very rapidly. They owned the whole of the patents for Europe, and proposed to dispose of the foreign patents as soon as possible. Mr. Johnson and he were bound for the Continent next week in connection with negotiations that had been going on for the sale of one of the foreign patents, and he had every reason to hope they would dispose of it at a satisfactory price. Replying to questions, the chairman said that in the automobile department they had not done any further business, but they anticipated great developments in that industry. Mr. Johnson, in the course of a lengthy statement, said he had advices from their associate, Mr. Lundell, in America, that he had completely standardised all the various types which were required in the operation of the different styles of tramways. Within 30 or 40 days they would probably have all their machinery available, and they would undoubtedly be in a position to take on contracts of any magnitude. The business of traction was developing in this country with great rapidity, and the field was practically unlimited. Much larger cars were being run in trains in America. This was developing more rapidly, and many of the trunk lines there were putting down electrical equipment for 25 or 30 miles of the termini of their lines in order to operate their suburban service over the main line. This practice would undoubtedly be followed shortly in this country. Councillor Henderson, Dundee, asked if he was right in understanding that they had not yet been in a position to tender for actual work so far as patents were concerned, but that in about six weeks they expected to have matters so completed as to be able to undertake work? The chairman replied that Mr. Johnson had referred more particularly to the motor business. As a matter of fact, Messrs. Holmes, of Newcastle, the licensees, were building motors as fast as they could and selling them to the company. The company were tendering for two jobs advertised this week. There was no difficulty in their tendering for work up to the capacity of Messrs. Holmes' works. Councillor Henderson asked whether any contracts had been secured. The chairman said the company was earning royalties at present on the work Messrs. Holmes was executing. They had three negotiations on hand for the early introduction of their surface contact system. In this connection Mr. Johnson stated that they would certainly have an opportunity of introducing this system of traction into England this autumn, and he was convinced that it would at once become the preferential system of supply.

German Electrical Companies.

In a recent letter from the Berlin correspondent of the *Financial News* the following notes are given regarding the financial condition of certain German electrical manufacturing companies. The Fabrik Isolirter Drähte für Elektrische Zwecke (insulated wire for electrical purposes) in Berlin has raised its capital from £12,500 to £62,500, and will issue the new stock at not under 120 per cent. value. The new capital is necessary to cope with the increased business, and to permit the buying of larger quantities of raw material. To produce popular electrical goods in large quantities a new firm has been founded, called Von Orth & Co., Limited, in Charlottenburg, having a capital of £5,000, and being under the managing direction of Engineer Dr. Ludwig von Orth. Körting's Elektrizitätswerke A.G., in Hanover, made last year a net profit of £6,300, which enables the board to propose a dividend of 6 per cent., after writing off large amounts and providing for the reserves. £50,620 is the net profit of the A. G. Elektrizitätswerke, O. L. Kummer and Co., in Dresden, which will pay 10 per cent. dividend to their shareholders, against 11 per cent. last year. Kommerzienrath Guilleaume, of Felten & Guilleaume Carlswerk A.G., in Mulheim-on-Rhein, has been asked by the French Government to act as judge for distributing prizes and awards for the rubber and cable sections. At the last board meeting of the new Kabelwerk Rheydt A.G. in Rheydt-Rhld it has been decided to ask for another payment of 10 per cent. of the subscribed capital to furnish and work the rapidly-growing factory buildings. The Union Elektrizitäts-Gesellschaft in Vienna, last year's amalgamation of L. Loewe and Co. and Vogel & Vool, from which the new firm has taken its name, closed their first business year with the small surplus of 115,000 kronen, which was carried forward. Orders for over 8,000,000 kronen are on hand.

Windermere and District Electricity Supply Company.

The annual general meeting of this company was held at Windermere on Monday, Mr. William Long presiding. The report stated that the trading profit for the year amounted to £1,112, and after payment of bank interest and other obligations, there remained a balance of £970, £949 of which had been applied to the payment of dividend on the preference shares, and the remainder carried forward to next year's account. The company had acquired the entire property and goodwill of the Keswick Electrical Company, and had come to an arrangement with the Ambleside Urban Council to take over their provisional order on favourable terms. The Chairman moved the adoption of the report and accounts.

Mr. J. S. Raworth, in seconding, regretted the non-payment of dividend on the ordinary shares. The directors had come to the conclusion to raise the price of lighting from 6d. to 7½d. per unit.

Mr. F. Fowkes, managing director, in reply to a shareholder, said the company had no connection with the British Electric Traction Company further than having entered into a contract to supply that company with electrical energy as soon as the Lake District Tramway was made.

The report was adopted, and Mr. J. P. Fawcus, of Keswick, was reappointed a director.

Blackpool and Fleetwood Electric Tramway Company.

The half-yearly meeting of the shareholders of the Blackpool—Fleetwood Electric Tramway Company was held at Fleetwood on Thursday last week, Mr. G. Richardson presiding. During the half-year the trams carried 660,000 passengers, the gross receipts being £10,125. The receipts were less owing to bad weather. The total expenses per mile were 7¾d., and the receipts 11¾d. A dividend at the rate of 4 per cent. per annum was agreed to.

Stock Exchange Notices. — The Committee has appointed Thursday, September 13th, a special settling day in Potteries Electric Traction Company, Limited—£125,000 4½ per cent. debenture stock, and has ordered same to be quoted in the Official List; also Edmundson's Electricity Corporation, Limited—Further issue of 9,400 ordinary shares of £5 each, fully paid, Nos. 17,401 to 17,407 and 26,108 to 35,500.

Wirral Railway Company.—At the half-yearly meeting held on Tuesday at Newbrighton, Cheshire, Mr. T. H. Jackson the chairman, proposed the adoption of the report, and after explaining the position of the company, said that having obtained powers to work the lines by electricity, the change would be proceeded with when a favourable opportunity presented itself. They hoped for good results from its adoption.

W. T. Henley's Telegraph Works Company, Limited.—On Friday last, at Cannon Street Hotel, an extraordinary meeting was held under the presidency of Mr. Sydney Gedge, M.P., at which the resolutions passed on August 9th, increasing the capital, were confirmed.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 25th, 1900, were £1,845 1s. 11d.; receipts for corresponding period, 1899, £2,090 6s. 11d.; aggregate for half-year to date, £11,605 11s. 7d.; aggregate corresponding period of last half-year, £11,990 18s. 3d.

The Bristol Tramways and Carriage Company.—The receipts for the week ending August 24th, 1900, were £3,453 16s. 2d.; corresponding period, 1899, £3,692 18s. 3d.; decrease, £239 2s. 1d.

The Central London Railway.—The receipts for the week ending August 27th, 1900, were £4,385; previous week, £4,579; decrease, £194. Total receipts (4 weeks), £18,329. Miles open, 6.

The City and South London Railway Company.—The receipts for the week ending August 26th, 1900, £1,473; August 27th, 1899, £895; increase, £578. Total receipts for half-year, 1900, to date, £12,008; corresponding period, 1899, £7,662; increase, £4,346. Miles open, 1900, 4½; 1899, 3½.

The Cork Electric Tramways and Lighting Company.—The receipts for the week ending Thursday, August 23rd, 1900, were £463 9s. 6d.; corresponding week last year, £505 19s. 5d.; decrease, £42 9s. 11d. Total to August 23rd, 1900, £3,702 6s. 10d.; corresponding period last year, £12,503 1s. 5d.; increase, £1,199 5s. 5d.

The Dover Corporation Tramways.—The receipts for the week ending August 25th, 1900, were £324 6s. 0d.; August 26th, 1899, £346 16s. 6d.; increase, £22 10s. 6d. Total receipts to date, 1900, £6,834 11s. 3d.; corresponding period, 1899, £6,488 0s. 9d.; increase, £346 10s. 6d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 5,204; 1899, 4,966. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 24th, 1900, were as follows:—D. U. T. Co., horse cars, £29 11s. 6d.; ditto, electric cars, £3,729 9s. 1d.; D. S. D. Co., electric cars, £1,048 11s. 3d.; total, £4,807 11s. 10d; corresponding week last year—D. U. T. Co., horse cars, £2,525 3s. 8d.; ditto, electric cars, £1,469 12s. 1d.; D. S. D. Co., electric cars, £1,689 3s. 8d.; total, £5,633 19s. 5d. (Horse Show, 1899); decrease, £826 7s. 7d.; aggregate to date, £39,868 12s. 1d.; aggregate to date last year, £37,319 14s. 6d.; increase to date, £2,548 17s. 7d. The mileage worked is 43 miles electrically, 1 mile by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending August 25th, 1900, were £809; corresponding period, 1899, £810; decrease, £1. Total receipts to date, 1900, £16,704; corresponding period, 1899, £13,061; increase, £3,643. Miles of track open, 1900, 14; 1899, 6½. Number of cars, 1900, 29; 1899, 14.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 26th, 1900, were £1,767; corresponding week last year, £1,899; decrease, £132. Total traffics from July 1st, 1900, £13,960; ditto corresponding period, 1899, £13,661; increase, £299. Miles open 6·57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The general Stock Exchange markets have developed a hardening tendency this week, despite the fact that the money position is not so happy as it was a few days ago, and the talk about "the autumn stringency" which is in the air. There is a general impression that Lord Roberts now holds the South African situation in his own hand, and is only gathering up all the lines before striking the blow which shall finish the war once and for all. Whether this be a right view or not, the news has so far provided satisfactory reading this week, and there has been a little investment following in the train of the improved feeling of confidence.

The better tone now prevailing can be gauged by noting that Electric Supply Debenture stocks are coming into demand, and there is a gradual absorption by the public of stock which for a long time has been lying idle in the hands of underwriters. The movement will do much to strengthen the share market, if it continues. So far it has had but little influence upon quotations for the Debenture stocks, the only alteration in the list being London Electric Supply 4 per cents., which are a point higher. But the effect will be felt very quickly if, as we have said, the buying should be extended.

Electric Supply shares are somewhat irregular. As might have been expected, Notting Hills are weak, and have lost £1, which more than wipes out their last week's advance. Selling of the old shares in order to take up the new is primarily responsible for the decline. The new are quoted 1 to 1½ premium, the same as they were a week ago, but 15s. below the price at which dealings were started in them. We would suggest that there are few better shares to be bought in the supply market than these new Notting Hills.

City of Londons appear to have touched bottom for the time being, the price having remained at 8 for the past fortnight. Charing Cross new Preferences are being actively dealt in at a small premium, the price being 5¼ to 5½. The shares, it will be remembered, were issued to proprietors of the old at £5 2s. 6d. apiece. These older Preferences are also better. Westminsters continue in quiet demand, and so do St. James's, but County Preferences have lost the support accorded to them last week, and lost, too, the 10s. which they then gained.

British Electric Tractions are a good market, country orders to buy having come in from the provincial centres and catching the market short of shares. A good report is predicted from the Potteries Electric Traction, the price of the shares resting in the meanwhile at 12. The London United Tramways Company is pressing forward the electrifying of its lines with all speed.

The so-called jubilee of submarine telegraphy—Tuesday, August 28th—failed to stimulate the telegraph stock and share market, which is firm but quiet. There is a little latent nervousness still left, which looks askance at the preliminary order for 32 sets of Marconi wireless instruments that is said to have been given out by the Admiralty. How great a scare the original suggestion caused can be seen by looking up the quotations of only 12 months ago. There is no change to report in either Eastern Ordinary stock or "China" shares. Anglo-American Deferred is down ¼, and we fail to see any justification for its standing as high as it does. Eastern 3½ per cent. Preference is a point up, and to the same extent West India and Panama Second Preferences have receded, the latter on some very premature fears that the company may not be able to pay the dividend in full next November.

All the Central London shares have dropped ¼—not a very surprising fact now that the first flush of excitement about the line has passed. The second week's traffic, showing a decrease of £463, was voted bad, although to us it seems most natural. But what most assisted the fall was the excellent results secured last week by the Metropolitan Railway and the omnibuses. Taking it all round, it is not a bit surprising that the price should have receded. City and South London stock is distinctly better, while Waterloo and City has again improved, both being bought by those in whose estimation the prices were unduly depressed. The outlook for railways, however, hardly justifies any particularly rosy view of the market.

A large number of calls upon recently-issued electric securities fall due in September. The Blackheath and Greenwich Company demand 25 per cent. on Saturday, September 1st, on the new debenture stock, and on the same day the new British Electric Tractions become fully paid, the Ordinary upon payment of £5 per share and the Preference of £4. The Telegraph Manufacturing Company requires the £4 due, also, on Saturday, which will make its recent issue of 5,000 Ordinary shares paid up in full. The other calls become due mainly at the end of the month.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation August 22nd.	Closing Quotation August 29th.	Business done during week ended August 29th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s.	73/6	58 — 61	58 — 61 xd	60½	58
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	110½—111½	110½ 111½xd	111⅜	110½
3,062,240	Do. do. Deferred	Stock	...	18s. %	£1 7s.	12½— 13	12½— 12¾	12 9/16	12⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	4 %	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102¼	101½
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15 — 16	15 — 16	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 —104 %	...	...
60,710£	Direct United States Cable	20	3¼%	3¼%	3 %	11 — 11½	11 — 11½	11¼	11
111,000	Direct West India Cable, 4½ % Reg. Deb. ...	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	145 —150	145 —150	147½	145
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	96 — 99	97 —100	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14⅜— 15¼	14⅜— 15¼	15 1/16	14⅞
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	... — ...	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	... — ...	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	110 —115	110 —115 xd	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102 xd	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103%	...	...
180,227	Globe Telegraph and Trust	10	4⅛%	5⅛%	5⅛%	11 — 11½	11 —11½	11⅜	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	14⅜— 15¼	14⅜— 15¼	14⅞	...
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	12½%	...	31 — 33	31 — 33	...	...
84,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —101	98 —101	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	51 — 55	51 — 55	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs. ...	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	¼— ½	¼— ½	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	4⅝— 4⅞	4⅝— 4⅞	4 13/16	4 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	13⅝	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	4⅞— 5⅛	4⅞— 5⅛xd	5 1/16	5
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 —100	97 —100	99½	98½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	100 —103	100 —103	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4¾— 5¼	4¾— 5¼	...	...
16,639	Do. do. 5 % Cum. pref. Nos. 1—16,639	5	...	...	...	5 — 5⅛	4¾— 5¼	...	...
179,947	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	99 —102	99 —102	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	... — ...	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜— 15¼	14⅜—15¼ xd	15 1/16	14⅞
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	2⅝%	2 %	8⅝%	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	7	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	5 — 6	5	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	102 —105	102 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref....	5	7 %	...	...	8½— 9½	8½— 9½	8⅝	8¾
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5⅛	5¼— 5⅜	...	...
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	6 %	6½— 7½	6½— 7½	6¾	...
150,000	Do. do. do. % Deb. Stock Red. ...	Stock	4½%	...	...	108 —111	108 —111	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000...	10	10 %	6 %	4 %	7½— 8½	7½— 8½	8⅛	8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12 — 13	12 — 13	12½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	4 %	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11 — 12	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	107 —110	107 —110	...	...
26,100	Edmundson's Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	...	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	99 —102	99 —102	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1 — 1½	1 — 1½	...	...
49,840	Do. do. do. do. 6 % Pref.	5	...	6 %	...	3½— 4½	3⅝— 4⅛	4⅛	4
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —100	99 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	14 — 15	14 — 15	14 1/16	...
220,000£	Do. 4½% First Mortgage Debenture Stock	...	4½%	...	...	111 —114	111 —114	...	...
220,000	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 98	96 — 98	97½	96½
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	15½— 16½	14½— 15½	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15 xd	14 7/16	14⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8 — 9	8 — 9 xd	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95 xd	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3 — 4	3 — 4	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	12 %	13 %	12 — 13	12 — 13	12⅜	12¼

* Subject to Founders Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Aug. 22nd.	Closing Quotation Aug. 29th.	Business done week ended Aug. 29th, 1900. Highest	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2⅞— 3⅛	2⅞— 3	...	...
90,000	Do. 4¼ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
30,000	British Electric Traction	10	...	6 %	...	14 — 15	14½— 15½	15½	14½
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅞	12½
200,000	Do. do. 5 % Perpetual Debenture Stock	Stock	...	...	...	123 —126	123 —126	...	...
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅜— ½	⅜— ½	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000	...	...	...	...	⅜— ⅞	⅜— ⅞	...	...
500	† Do. do. 4¼ % 1st Mort. Deb.	100	...	...	...	97 — 99	97 — 99	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11½— 12½	11½— 12½xd	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,000	5	...	...	...	5⅞— 6¼	5⅞— 6¼xd	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 1⅞	1⅝— 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛— 2⅜	2⅛— 2⅜	2⅜	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	108 —113	108 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red	Stock	...	...	...	101 —103	101 —103	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000	5	12½%	15 %	15 %	13 — 14	13 — 14	13½	13
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red	S ock	...	...	...	110 —114	110 —114	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	9⅞— 10⅛	10⅛	9⅞
61,033	Do. do. Pref. half-shares	5	...	...	...	5 — 5⅛	4⅞— 5⅛	...	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	4⅞— 5⅛	5⅛	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	55 — 58	57 — 60	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	5 — 6	5 — 6	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	7½%	3⅞— 4¼xd	3⅞— 4¼	4⅜	4
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	6 %	1⅞— 2¼xd	1⅞— 2¼	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	6 %	3½— 4¼xd	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red	100	...	...	...	91 — 93	89 — 91	92¼	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1⅝— 2⅛	1⅝— 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000	2	7 %	7 %	...	2⅜— 3¼	2⅜— 3¼xd	...	...
140,300	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	...	...	...	102 —105	102 —105	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600	10	7 %	7 %	7 %	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13 — 14	12½— 13½	12⅜	...
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5 — 5½	5 — 5½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works	10	10 %	10 %	...	21 — 22	21 — 22	21⅛	...
300,000	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¼%	3¼%	8⅝— 9	8⅝— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39	35 — 39xd	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909	100	...	...	...	101 — 104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	8 %	12 %	10½— 11½	10½— 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000	5	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	90 — 93	91 — 94	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 102—104.
National Electric Free Wiring, 12/6 paid, 7/- —9/-.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16½—17½.
Do. do. Pref. (£10 pd.), 10—10¼.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13; 1st Preference Cumulative 6 % £5 (fully paid), 7—7¼. Debentures, 102—104. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (July 19th, 1900).

MARKET QUOTATIONS, Wednesday, August 29th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal)	per ton	£33	£33	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£17	£17	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	2¾d.	3¼d.	..
METALS, &c.				
b Aluminium Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£80 to £150	£80 to 150	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	7¾d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn)	per lb.	8¼d.	8¼d.	..
c ,, Wire, basis	per lb.	8¼d.	8¼d.	..
c Copper Tubes (brazed)	per lb.	11½d.	11½d.	..
c ,, ,, (solid drawn)	per lb.	11d.	11d.	..
g Copper Bars (best selected)	per ton	£85	£85	£1 dec.

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£86	£1 dec.
g ,, Rod	per ton	£85	£86	£1 dec.
e ,, (Electrolytic) Bars	per ton	£83 10	£83 10	..
e ,, ,, Sheets	per ton	£92	£92	..
e ,, ,, Rod	per ton	£85 10	£85 10	..
e ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha fine	per lb.	8/6	8/6	..
h India-rubber, Para fine	per lb.	3/11½ to 4/2½	3/11½ to 4/2½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	71/9	71/9	..
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8	per ton	£12 15	£12 15	..
g Lead, English Ingot	per ton	£17 15 to £18	£17 12 6 to £17 17 6	inc.
g ,, ,, Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£9 5	£9 5	..
d Mica (in original cases), small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/8 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£3 13 6	£3 13 6	..
p Silicon Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£137 to £139	£143 to £144	£6 dec.
g ,, foil	per lb.	2/-	2/-	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1/9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb b'ndl's	per lb.	8¼d.	8¼d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs.	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs.	per lb.	5¾d.	5¾d.	..
j ,, Jute, 180 lbs. rove	per ton	£14 10	£14	10s. inc.
k Zinc, Sh's. (Vielle Montague and.)	per ton	£24 5 nett.	£24 5 nett.	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yeo & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

YORKSHIRE IRON.

In these days of steel few realise that best Yorkshire iron is still largely manufactured by the Farnley Iron Company, the Low Moor Iron Company, and a few other firms. Attention is called to this fact in the pages of *Cassier's Magazine* by Mr. Ewing Matheson. Steel is so essentially homogeneous that it possesses the faults of this quality. An incipient fracture makes an easy progress through such a material, and a crack in a steel plate will creep right across such a plate, and can only be checked by drilling a small hole at the end of the crack, and such a hole must actually remove the very end of the crack, or must be so placed that the progress of the crack will meet the hole. Any trace left beyond the hole will start the movement forward once more. Best Yorkshire iron is a careful combination of innumerable layers of a pure and tough substance, in the manufacture of which every care has been exercised to avoid the usual defects of ordinary iron in the shape of cinder, sulphur, and other impurities, and of deficient working, improper and careless piling or fagotting, or defective puddling. Best Yorkshire iron is made near Leeds from clayband ironstones, which are found in nodular form in a shale above the coal which melts them. These nodules are 33 per cent. iron. The ore when mined is left to weather for some months to loosen the surrounding shale from the true nodule, and the shale is further removed by calcining. The Better Bed coal is used in the making of the coke to smelt the iron. This seam is non-sulphurous, and about 3,000 lbs. of coke will smelt 4,400 lbs. of ore, the limestone flux weighing 11,000 lbs. and the product being 2,000 lbs. of iron.

The cold blast process is the one employed, and the furnaces are lined with firebricks made from the clay found under the Better Bed coal seam. It is the same clay from which glazed bricks are made, for the Leeds bricks are highly burned to a more durable enamel than a less refractory brick could stand. The blast pressure is 3½ lbs. per square inch, and the pig produced is tough and strong, and a bar 2 inches deep by 1 inch wide, on bearings 3 feet apart, will carry from 30 to 32 cwt. breaking stress. The pig thus produced is refined by a re-melting process, and is run into shallow iron moulds. It is thus purified of silicon and reduced in its carbon. It is puddled by re-melting with coal and puddling in the usual manner, whereby it becomes practically pure iron, the puddle balls being then hammered, and in place of being at once rolled into puddled bars, or muck bars, as termed in America, they are welded together under the hammer, re-heated and forged into blooms of 160 to 300 lbs. weight, from which they are rolled into bars and plates.

The iron thus produced is uniform, but is not homogeneous. It is fibrous in its nature, but the fibre is clean. It is tough, soft, and ductile, and of great strength and considerable resistance to corrosion. It is easy to work, and produces safer welds than can be made with steel, and it does not fracture from an incipient crack in the certain manner peculiar to steel. Americans import best Yorkshire in considerable quantity for locomotive stay bolts. It is the best material for draw bars. The best chains are made of best Yorkshire iron, and the safety hooks and parts of mining cages are made from it.

It may not have the strength of steel, and it is more costly, but it is more reliable for such purposes, and for the parts of artesian boring apparatus it is especially valuable for its resistance to complete fracture.

The mode of manufacture has remained practically unchanged for 50 years, but the tests are continued so as to prove the equally continuous excellence of the quality.

For the above and other parallel uses there is so far no material that can touch best Yorkshire iron for safety. It should be used for the brake rods of electrical tramcars, and such parts as are to be relied on for safety. Users should, however, see they get it. We regret to say we have seen electric cars which, while they certainly had iron brake rods, did not have them of best Yorkshire. Yet the suppliers of inferior iron rods are not, we fear, to be easily rendered amenable to the law.

ST. PANCRAS ELECTRIC LIGHT MAINS.

Abandonment of Copper Strip Mains in Favour of Cables.

During the past two or three years the Electricity and Public Lighting Department of the St. Pancras Vestry has been, and is still, engaged on the work of converting the system of supply from 110 volts to 220 volts, and it may, therefore, be of interest to refer to several matters which have arisen in connection with the transformation from the low to the higher pressure.

In the first place, reference may be made to the proposal to alter the copper strip mains so as to carry the 220-volt supply, and to change over the consumers from the Britannia, High Street, to the St. Pancras boundary in Tottenham Court Road on both sides of that thoroughfare. As the work would naturally involve considerable expenditure, negotiations were entered into with the London County Council as the sanctioning authority for loans, the correspondence on the subject having commenced as far back as November, 1897. The London County Council was, however, not satisfied with the information supplied, especially in regard to the allocation to capital account of certain charges to be incurred by increasing the capacity of the mains. In June, 1899, the Vestry, in reply to a letter forwarded by the County Council in the previous month, submitted further information dealing with the work necessary to be executed in readiness for the anticipated load during the winter of that year. This showed that the estimated cost of examining and increasing the insulation of existing mains for the purpose of increasing their revenue earning capacity, with the minimum expenditure of capital, would be as follows:—

Mains in Camden Town on each side between the Britannia and the Cobden statue, including labour and materials	£1,365
Mains in Hampstead and Tottenham Court Roads on the west side from the Cobden statue to Windmill Street	3,178
Mains in Hampstead and Tottenham Court Roads on the east side from Drummond Street to the parish boundary	1,074
Cost of changing lamps in consumers' premises along routes ..	665
Sundry expenses in changing over consumers	640
Allowance for probable advance in materials up to the time of completing the work—say, 5 per cent. on £6,923	346
	£7,269

The Vestry pointed out to the County Council that the approximate total expenditure of £7,269 for the work along the routes mentioned would increase the capacity of the mains sufficient to enable them to deal with all future demands. On the other hand, if the existing mains remained as they were, with the pressure at 110 volts, and extensions were put in hand to deal with the total estimated demand, the cost for extra mains along the routes would be £23,731. Having regard to the estimate of £7,269, the Vestry stated that the enormous saving in capital expenditure was self-evident, and greatly exceeded the cost of increasing the insulation and pressure of the supply on the existing mains, and it was therefore submitted that the expense of effecting the change was a fit and proper item justly chargeable to capital account.

Difficulty with the County Council.

It was still impossible for the Vestry to meet the requirements of the London County Council, which next asked for particulars as to the capacity of the mains in question. Mr. Sydney W. Baynes, in February of the present year, informed the Council that the mains were capable of dealing with some 9,400 16-c.p. lamps, that he proposed to work them when altered at a maximum of 28,000 16-c.p. lamps, and that by not pressing the mains up to their maximum after the change, better regulation would be obtained. On the question of the capital expenditure for changing the mains, the electrical engineer mentioned that if the Vestry eight years previously had put down the full complement of copper in the districts proposed to be altered, an expenditure of £23,731 would have been incurred, and the interest and repayments over the eight years would have amounted to £10,800. The electric lighting department had therefore benefitted very materially by the foresight manifested in that respect. Further than that, the Vestry was now in a position to obtain the advantages of the higher voltage, not only along the old routes, but in all future extensions, without sacrificing a very large portion of main, which would have been the case had the Vestry installed the full complement of copper at the outset. The saving in capital on mains (when working at the new voltage) would enable the gross profits to be increased from 6 per cent. to 8 per cent. or more on the total capital expenditure. Since the output of these mains would be increased by the alteration to an equivalent of that which would have been obtained by expending three times the capital, and as the Vestry would be able to add three times the consumers, the electrical engineer stated that it followed that the mains laid along the route would be increased in capital value to that amount, in so far as their value to the installation was concerned. The letter concluded with a request for a prompt decision, owing to the urgency of the matter.

The County Council's Decision.

The vacillation of the London County Council continued until May 15th last, when a letter was forwarded to the Vestry from the Comptroller. This letter, which decided the question of defraying the expenditure on a peculiar basis, was as follows:—

> I am directed by the Finance Committee of the London County Council to inform you that they have very carefully considered the question in its financial bearings, and have received several reports from their chief engineer upon the matter. Generally speaking, the Council would be disposed to grant the same facilities to a borrower as they themselves are allowed by the Government Department which has supervision of their capital disbursements, viz., that, after a work or undertaking is completed, only such part of the cost of subsequent alterations is charged to capital account as can clearly be proved to increase the value of the work as a whole. The Vestry will appreciate the fact that there is some difficulty in applying such a principle to works connected with the supply of electric light, because of the rapid development of knowledge on this subject which has taken place within the last few years, and is likely to take place in the future. Under these circumstances, and in order to meet the justice of the case, the committee would be prepared to consider an application for a loan for such "improvements" as are under consideration, the amount of which had been arrived at somewhat in the following manner:—
>
> Starting with an estimate of the cost at the present time of laying the mains as now desired *as an entirely new operation*, and deducting therefrom the amount of loan now outstanding in respect of the mains as originally laid, and which it is now intended to replace, a sum would be arrived at in respect of which the Council would be disposed to sanction a loan, and the period of repayment would be such as, in the opinion of the Council's chief engineer, might be taken as the fair life of the new works.
>
> I am further to state that any preliminary arrangement between the Council and the Vestry would be subject to the sanction of the Treasury being obtained thereto, as it is not the intention of the committee to recommend the sanction of a loan for a purpose, or for a period, for which they could not also recommend the Council to lend the money. I am also to ask what is the amount of the fund created by the Vestry to provide for replacements and renewals in respect of the initial expenditure upon the mains now intended to be replaced.

Comparative Methods of Executing the Work.

It would appear that pending the receipt of the deciding letter from the London County Council, the Vestry invited tenders for overhauling the copper strip in anticipation of being able to carry out the work on the basis of treating the whole of the expenditure as fresh capital outlay. Two tenders were received, but only one

related to the actual work required. This was submitted by Messrs. Crompton & Co., and amounted, including the addition of certain items for street covers for insulators, straining bars, reinstating pavements, and other works, to £5,849. The other tender, which emanated from the Western Electric Company, and proposed the removal of the copper strip and the substitution of lead-covered armoured mains, reached a total of £4,836. Whilst these tenders were under consideration, the above-mentioned letter arrived, announcing the terms upon which the Finance Committee would be prepared to recommend the County Council to sanction the proposed expenditure. As the Electricity Committee, after having been in correspondence with the County Council on the subject for no less than two years and a half, did not feel disposed to accept the method proposed for allocating the expenditure, the electrical engineer suggested that the difficulty might be overcome by laying auxiliary cables along the route, and leaving the copper strip untouched. The existing 220-volt consumers were merely to be transferred to the auxiliary mains to a sufficient extent to relieve the overload on the copper strip, and the auxiliary mains were to be large enough to carry all new customers as far as could be reasonably calculated. Another reason adduced in favour of the scheme was the impossibility of changing over all customers from 110 volts to 220 volts. For instance, the transformation was out of all question in the case of the delicate instruments at University College, whilst it was considered that even if altered for the higher pressure, some of the installations in Tottenham Court Road would not be passed by the fire insurance companies. The Electricity Committee accordingly decided to invite tenders for the laying of auxiliary mains, and thus place the Vestry in possession of the cost of carrying out the work in three different ways, two of which have already been cited in the case of the tenders of Messrs. Crompton and Co. and the Western Electric Company.

The electrical engineer in reporting on the subject, stated that the cost of overhauling the copper strip (£5,849) and changing over customers to 220 volts would appear to be prohibitive. This was not surprising as the constantly varying levels of the culverts, involving a lot of extra anchoring gear, and the uncertainty as to the amount of labour necessary per yard of trench, tended to influence any offer a contractor might submit. Moreover, as the supply must be maintained at all costs, a contractor would have to provide against loss of time, &c., consequent on the very unfavourable conditions under which he would be called upon to execute the work. The second method—the removal of the copper strip, laying cables in the culverts, changing consumers over to 220 volts and allowing credit for the copper—was undoubtedly the best from a purely engineering point of view. The engineer anticipated that the competitive tenders then invited would have the effect of reducing the amount quoted in the tender of the Western Electric Company. In his opinion, the reason why a lower bid could be obtained for the substitution of cable for strip was that firms quoting were able to gauge with more exactitude the amount of labour likely to be required, and they would have a better knowledge of the time it would take to finish the contract. There was also the advantage that the drums of cable could be kept alive with the current during laying, and thus customers could be more readily and rapidly connected as the work progressed. With regard to the third method—the laying of auxiliary cables as already mentioned—the electrical engineer considered it desirable to remove certain misapprehensions as to the value and ultimate use of the copper strip.

The Value of the Copper Mains.

The report on the first point states:—

The whole of the copper strip mains, old and new, cost, according to our books, £33,683. Of this there is a great deal which is in a suitable condition to carry the extra pressure. That portion between the generating station in Stanhope Street and the pneumatic tube, also the whole of the feeders and distributors in the tube, both along Drummond Street and Hampstead Road, to end of Tottenham Court Road, Gower Street, and a portion of Euston Road, are in a fit condition for the new pressure. Park Street, from the Britannia right round to Cumberland Terrace, and Camden Town to Wellington Street from the Britannia is already working on the higher pressure. Deducting these, we find that the approximate money value of the copper strip mains unfit for the new pressure represents some £14,900, and not £60,000, as first anticipated. But if the work is executed as C (third method with auxiliary cables) this £14,900 worth of copper strip mains will continue in service, and the chances of their gradually falling into disuse are remote. By providing the auxiliary mains we are able to gain the advantage in the economy of the 220-volts supply all over our principal thoroughfares at once, without disturbing or inconveniencing any of our old customers. The large revenue expenditure changing them over will be avoided, and (so long as they signify their willingness to change over, should it be deemed expedient at any future date) there is nothing to prevent them receiving the benefits available from the reduced scale of charges. When the routes provided for in the specifications issued are dealt with, it will be many years before the remaining portion of the strip mains in other parts of the parish are loaded up, so that we may assume that we have at last come to the end of expenditure on this account, unless unforeseen developments occur.

The Future Use of the Copper Strip.

As to the second point, the report says:—

Returning for a moment to the future of the copper strip mains in Tottenham Court and Hampstead Roads, the forced removal of the feeding mains from the pneumatic tube, or even a greater growth of larger and more imposing buildings than anticipated may necessitate the clearing of these copper strip mains of all consumers, who would then be transferred to the auxiliary mains and changed to 220 volts, and these copper strip mains used as positive feeders or sub-feeders as necessity may arise; additional cable negative feeders being laid and paired off with a strip positive. The engineer's trouble is always to keep up the insulation of the negative main, which has a constant tendency to fall, and here that would be met by the higher insulation of the cable negative, and the strip positive could then be used safely at 440 volts without any expenditure for overhauling, whilst the chances of explosion or short circuits would be reduced to a minimum, the whole of the copper then being of the same polarity.

The auxiliary mains have not been provided large enough to carry the old customers as well as all new comers, so that should the necessity arise for changing *all* to 220 volts the copper strip would have to be utilised *as a necessity* somewhat in the way indicated, but without laying any companion feeder, merely changing the polarity of the existing feeders and pairing them off with a strip positive.

The electrical engineer expressed the opinion that the third scheme would prove to be the best and most economical. The tenders received were as follow:—The British Insulated Wire Company, £2,675; the Western Electric Company, £2,618; Siemens Bros. & Co., £2,575; and Callender's Cable Company, £2,506. The offer of the Western Electric Company was accepted for the supply of the cables at a meeting of the Vestry in July last, and it was decided to carry out the work of laying the cables by the Vestry's own staff. An attempt was made at the time by Messrs. T. Rutter, D. Davies, W. H. Matthews and others, to get the report referred back for further consideration on the ground that the proposal implied the abandonment of the copper strip mains, and therefore a heavy dead loss to the parish. So close was the voting, that the amendment was defeated by a majority of two votes only, but after receiving an explanation by Mr. S. W. Baynes the Vestry decided, by 38 votes to 8, to accept the tender as already stated, and the work should now be in progress, so as to be completed in time for the coming winter's demand.

NIAGARA FALLS WORKS.

By ORRIN E. DUNLAP.

When the new Niagara power wheel-pit is completed it will have a depth of 180 feet, and of this depth about 80 feet have been excavated, leaving 100 feet of rock still to be taken out. It is believed that this wheel-pit is the largest hole ever sunk in the ground at one time in any part of the world. In length it will be over 463 feet, and the width will be about 17 feet. This forms an immense hole to cut through solid rock at one time. When the original wheel-pit was built it was excavated in sections, but the prospective demand for power made it necessary that the entire new pit be excavated simultaneously.

The scene about the wheel-pit site is one of remarkable activity, and on all sides many men are engaged in the various tasks that go to bring about the desired result—the completion of the pit at the earliest possible moment. When the pit was commenced in November last, it was expected that the contract would take 20 months to perform, and this will bring the completion about June, 1901. The contract is held by the National Contracting Company, one of the strongest contracting companies in the United States, and it has brought a vast plant to the grounds to build the pit and connected works. The consulting engineer of this company is George B. Burbank, who was chief engineer of the Cataract Constructing Company during the time of the tunnel building. He has had a vast experience with this class of Niagara work. The resident engineer (or local manager) of the wheel-pit work on the part of the National Contracting Company is Walter McCulloch, who also is familiar with all the requirements of the contract, and William A. Brackenridge, resident engineer of the Niagara Falls Power Company, looks after that company's interests.

Work on the pit progresses night and day. All blasting is done by dynamite during the off hours. Over the pit there has been erected a Lidgerwood patent cableway for the purpose of lifting the excavated material from the pit. This cableway is operated from two towers, one of them being 30 feet high, the other 60 feet. The cable used is of steel 2½ inches in diameter. The length of cable between the towers is 600 feet, while the total length of cable used is 840 feet. The cableway has a lifting capacity of 10 tons. At each end of the cableway an anchorage has been provided by sinking a round oak log, 30 inches in diameter, and 25 feet long, 12 feet in the ground, and surrounding it with concrete, and loading it with piles of rubble stone. The bucket used on the cableway has a capacity of 2 cubic yards. It is run up close to the high tower, and there the rock is dumped into Goodwin gravity dumping cars. The aerial dump is used, and it is operated by the engineer located in a small building adjoining the high tower, so no men are required near the bucket or on the car. When the dump cars are loaded they are run to the trestle of the Niagara Junction Railway, where the material is deposited in order to form a roadbed, so that the line may be doubled tracked in the near future. This railroad is the terminal line on the lands of the Niagara Falls Power Company, and the very fact of its about to be double tracked is significant of the consantly growing business done on the lands of this company.

On one side of the pit the masonry wall at the top is well advanced. The manner in which the castings are placed in the walls as the work progresses, is a most important feature. These castings are of various shapes, each being required for a special purpose. There are castings for bearings, castings for struts, castings for girder bearings, and castings for penstock bearings, and all of these must of necessity be placed in their proper places in the walls, in order that they may perform the required service in the complete work. This work of channelling the walls of the pit is said to be the largest ever done on any single contract in the United States before.

In the inlet canal the cofferdam has been completed in front of the pit location. This cofferdam is 550 feet long. It is formed of two stone-filled cribs with a clay puddle between them. Its purpose will be to keep the water back during the construction of the inlets for the new pit.

The shaft, 10 by 16 feet, in the inlet canal bed in front of the power house, has been sunk into the tunnel heading a depth of 180 feet. The contract for this part of the work has been sublet to A. C. Douglass by the National Contracting Company, and he has progressed over 200 feet in the excavation of the upper bench of the tunnel extension. The length of this extension will be 616·5 feet, and will extend on a curve from the present pit to the new pit. The length of this curve will be 368½ feet, while it will have a radius of 186½ feet. The tunnel extension is being built in the same section as the main tunnel, which is 18 feet 10 inches wide by 21 feet ¼ inch high, in the form of a horseshoe. The excavated material is raised to the surface by a derrick. About the mouth of the shaft in the canal bed there are being built solid masonry walls in order to protect it from the water when it is allowed to return to this section of the canal.

It will be recalled that the two wheel pits are to be connected by a tunnel located about 130 feet below the surface. In length this tunnel will be about 200 feet. It will be 6 feet wide and 8 feet high, lined with brick and lighted electrically. The pit will be lined with brick throughout, and the walls most carefully drained by a system heretofore mentioned in the Electrical Review.

In order to facilitate operations at night, 10 arc lamps have been placed in the pit, and a Wagenhall electric headlight has been installed on the high tower about 30 feet from the ground. The beam from this headlight is cast here and there where most needed, but principally along the cableway in order that the carriage may always be visible.

The plant that the National Contracting Company has erected on the ground is of considerable magnitude. The compressed air plant is said to be one of the best ever put up in the United States. In it are four Ingersoll straight-line air compressors known as Class A, and 10 100-H.P. boilers. There are also on the ground 10 Sullivan Machine Company's channelling machines; six Ingersoll-Sergeant rock drills; three Ingersoll-Sergeant gadding machines; two 3-ton locomotives; a 1¼ miles of track; 40 dump cars; three Goodwin gravity dump cars; 10 derricks and hoisting engines, and one Byer's travelling derrick of 5 tons capacity.

In the performance of the contract 32,000 cubic yards of earth will be taken from the pit and inlets; 68,000 cubic yards of rock will be taken from the pit, and 13,000 cubic yards of rock from the shaft and tunnels.

The material to be used will be 10,000 cubic yards of Portland cement concrete; 1,400,000 lbs. of iron and steel in the castings, pipes, and girders; 6,000 yards of cut stone masonry; 13,000 yards of brick, which means a consumption or 7,500,000 bricks, and in the cofferdams, &c., over 800,000 feet of hemlock have been used.

When the new pit is completed, 11 units of 5,000 H.P. each will be installed in it. While it is understood that changes will be made in the construction of these new turbines, still the engineers are not yet prepared to state just what the changes will amount to. It is likely that this will be decided within the next month, the plans and details now being worked out. The new power station will present some changes in construction, but the general idea of the present stone building will be maintained.

In this connection it may be remarked that the Niagara Falls Power Company now makes a charge for seeing the installation in the great power station, but the money thus collected goes for a noble purpose and not to enrich the company, which has no desire to thus profit. Ever since the power station has been in operation there has been a wonderful number of visitors, and for a long time they were admitted free. Now a fee of 10 cents is charged for the gallery view, and 25 cents pays for a trip about the floor in company with a courteous guide who explains all the features in an intelligent, clear manner, so that the visitor is greatly benefited. The money thus collected goes to endow beds for the employés of the Niagara Falls Power Company in the Niagara Falls Memorial Hospital. It has been still further suggested that a portion of the money so raised should be used as an insurance fund for the employés, and this may be done, but it is wholly prospective.

AMERICAN TRAMWAY PRACTICE.

It has frequently been remarked that the errors in English tramway practice have arisen from blindly following American practice, and having no justification for so doing. No thought seems to have been given to the differences of conditions. We have already alluded to the error in following American car practice with magnified horse cars, and only inside seats. We have long been struck with the unwise way in which American car wheels, with weak flanges on chilled wheels, have been set to do an entirely different service.

In America the rails of a tramway are not usually grooved. When grooved, the groove is of much more liberal proportions than are allowed in England, where grooves have to conform to certain authorised rules. When an American chilled cast-iron wheel runs on a grooved English rail, the flanges will break off in long pieces. The flange of a cast-iron wheel is like a fin projecting from the mass of a heavy casting. Its attachment to the wheel is poor, owing to the well-known phenomena of cooling and contraction stresses, and it is comparatively easy to break off such projecting pieces. The greater the projection of the flange the greater will be the contraction strains involved, and the liability to break. Cast-iron wheels are so much cheaper than steel-tyred wheels, that their use has become practically universal, but where cast-iron wheels fail to run in some cases less than an eighth of their proper mileage, it is open to question whether steel-tyred wheels are not after all cheaper. The fault, however, is recognised, and has been pointed out by Mr. Keagey in the *Tramway and Railway World*. He fully realises the cause of the failure, and points out that in Manchester the groove has been allowed to be 1¼-inch wide in place of the usual 1 inch. He shows also that the flanges are too deep. A flange so much as ⅝-inch has only been employed by two English tramways without trouble. Most lines use a ½-inch flange, and even a ⅜-inch flange may be used with advantage. We cannot ourselves see any good reason for flanges deeper than ½-inch at most, and we fail to find arguments against a depth of ⅜-inch. The chief working stress on a flange is probably that due to the causes to which we have already referred when dealing with cars, namely, the heavy lateral stresses due to the short truck taking a turnout. This stress is one that would be seriously reduced with double truck cars. Then there is the stress upon the back of the flange at points of wide gauge when the flange presses heavily on the lip, especially around curves. Of accidental causes there are frost, nails from the horses, or other pieces of iron which are responsible for many flange breakages. In every case the breakages would be minimised by a smaller flange, and the soundness of the flange would be improved, also, by the reduction of the depth of projection. Much trouble arises from faulty track laying. The accuracy of gauge necessary in tramway work does not appear to be realised by the platelayer of railway experience, and the use of the single bar gauge does not, we fear, lend itself to the accuracy that is desirable in tramways. Practice is far too diverse. There is no standard to which rails can be laid. Car builders, and makers of wheels and axles all seem to carry on in their own way as though such a question as standardisation had no existence. Though so many of them are Americans, they never seem to have heard of the Master Car Builders' Association, which has for years been moulding all American railroad car practice into one form, so that any truck of any line may be run under any car body in the country. Essential interfitting parts and leading dimensions are all made alike. Not so in tramway work, wherein may be found an endless variety of truck frames with different wheels and axles, and other details, so that the keeping of spares on any system that has purchased cars from more than one builder has become costly and laborious. What is required in England is, that these points should be taken up by such a body as the Tramways and Light Railways Association, and an attempt made to bring about a standard practice. Until this is done, there can be no economy in working and maintenance.

The present makers of trucks appear to aim at making their trucks different from others for the purpose of supplying repair parts at a maximum price, and we think all tramway managers will agree that repairs do cost many times what they should do, and that lots of castings are charged for in sovereigns where shillings would almost be sufficient under a proper system of standardisation. Practice has been adopted directly and blindly from America when it should not have been, while the system of the Master Car Builders' Association has been neglected, though it ought to have been strongly taken up.

ON THE RELATION OF THE PRICE AND EFFICIENCY OF INCANDESCENT ELECTRIC LAMPS TO THE COST OF ELECTRICAL ENERGY.

At the present low price of electric incandescent lamps, considerable economy can be effected by the use of so-called high efficiency lamps, because the cost of current during their life is many times the price of the lamp at the rates usually paid by the public in England for current, and if an incandescent lamp is overrun, the increase of candle-power-hours thereby effected, as compared with its life under normal conditions, is out of all proportion greater than the relative cost of renewals. A consideration of these facts, together with other allied circumstances, has induced the leading electric supply companies in the United States to undertake the supply and renewal of incandescent lamps in their customers' premises, a proportional increase being made in the rate charged for current. The question that suggests itself is at what limiting charge for current is the high efficiency short-lived lamp to be preferred to the low efficiency long-lived lamp? The terms high and low efficiency and life are purely relative, and are subject to modification from time to time by improvements in manufacture. To fix our ideas, let us assume that the life of a lamp is the number of hours during which this lamp will, when consuming its standard number of watts per candle at the standard voltage, emit a candle-power which does not sink below 20 per cent. less than the initial rated candle-power. Low efficiency may be defined as 4 watts per candle, and 3 watts per candle as high efficiency.

A 4-watt per candle lamp can now be relied upon to have a life, as above defined, of 1,000 hours. A 3-watt per candle cannot be relied on for more than 400 hours. The price of both lamps to the public may be taken at 1s. The 4-watt 16-C.P. lamp will consume $4 \times 16 \times 1{,}000 = 64$ units during its life, and the 3-watt lamp will consume $3 \times 16 \times 1{,}000 = 48$ units during the same period. The first lamp will call for one renewal, as against 2½ renewals in the second case. The total cost therefore will be in the proportion of $(64\,x + 12)$ pence to $(48\,x + 30)$ pence, where x is the price per Board of Trade unit.

When $x = 1{\cdot}125$ pence the cost in each case will be the same, and either arrangement will be as good as the other, on the basis of light obtained, but it must be taken into consideration that more labour is involved in renewals when the high-efficiency lamp is used, and if a number of the lamps happen to be in the ceiling of a lofty room, or in any other inaccessible positions, the extra labour may amount to a considerable item.

Assuming 2½d. to be the lowest rate at which electrical energy for private lighting is likely to be obtainable from the public companies' supply mains in the near future, the economy effected by the use of the 3-watt lamp, as compared with that of the 4-watt lamp, would be

$$64 \times 2{\cdot}5 + 12 - 48 \times 2{\cdot}5 + 30$$

$= 172{\cdot}0 - 150{\cdot}0$, or 22 pence in every 1,000 hours after allowing for renewals.

At anything like the present rates for current, however, the 3-watt lamp would appear to have very marked advantages both for the consumer, owing to the diminution of his bill for an equivalent number of candle-power-hours, and for the supply company who could produce more light for a given amount of copper in their mains and feeders.

UNDERGROUND LONDON.

A daily paper has been hunting up a couple of engineers who have reduced to black and white and put into a businesslike and practicable scheme an idea for connecting the many London railway termini to one central station. The idea of such a central station is not new. It was advocated in a technical contemporary several years ago as an electrical undertaking, the idea promulgated at that time being for a central station and a number of radiating lines joined up to an outer circle railway. It was suggested that to travel from one connected point to another on the system, the passenger would travel to the central station and there change into the radial line passing through their destination point. In the present scheme main line trains are to be run bodily on to lifts to be lowered into the tunnels. The platforms of such lifts would be about 400 feet long, and we do not see how, even if practicable, such lifts would have any advantage over inclined planes as at present employed. It appears that the present passenger lifts have so filled the mental vision of some people that they have run to seed, so to speak, in the shape of the proposed lifts. Having been no doubt full of their scheme, the ingenious engineers have spread themselves in the columns of the *Daily Mail*. They promise to clear off the heavy street van traffic, and so on, and generally to do a good deal more than their lifts would perform. Obviously the proposed lifts could be made. There is nothing much in a multiple ram lift, or even in a 400-feet centrally supported girder with a single ram. A 400-ton train on a 400-ton girder platform could be lifted by a 50-inch ram. The trouble of these schemes is, that they are too big. We have always contended that underground London ought to be planned out as a whole, with due regard to the depths of each part of the system, and full consideration of the crossing of one tunnel by another. This full system being determined upon, no section of it should be permitted to be made by the usual enterprise which now lays down ill-considered bits at improper depths without giving a thought to the crossing of other tunnels. By our system, when many pieces had been laid, a very little additional work would put them all into harmonious connection. The haphazard laying down of lines at the unbridled desire of various promoters must inevitably result in great ultimate inconvenience and loss of capital. Anything worse than London's surface, or rather overhead and suburban system of lines, cannot well be imagined, but we foresee a lamentable iteration of the same below ground that will be even less capable of adjustment or emendation. The trouble in London is that schemes are either so big as to be outside the capitalists' views, or they are so ill-considered as to be of little good. The subsoil of London is so peculiar that the system of buried lines is such as to be almost unique. Few other cities, if any, have such peculiar geological conditions, and yet the advantage of such are being sacrificed. The clay band in which tunnels can best and most cheaply be built, is not of an unlimited thickness, and on this account it is desirable that there should be an authoritative skeleton scheme along which construction should be allowed. This ideal scheme would be no hardship on promoters, but rather an aid to them, for any company who could show the capital would obtain a concession as a matter of course, and not require to bring costly evidence as to the needs and practicability of its scheme. Such a scheme ought to form the subject of investigation by the Board of Trade and a committee of engineers and business men.

LOSSES IN SMALL LIGHTING PLANTS.

[COMMUNICATED.]

Some tests in this connection were recently made by Profs. Swenson and Richter of the Wisconsin University.

It is seldom that a small electric lighting plant receives the attention it deserves, either in design or in maintenance. Nor is anyone in particular to be blamed for this. As a rule, a small plant means economy all round—economy in first cost, economy in working costs, economy in superintendence. Such plants are usually put together from manufacturer's catalogues, the nearest size of each element being chosen with due regard to what appears to be a proper allowance for "losses." These plants usually work all right and, to a certain extent, give satisfaction, but no one seems to have taken the trouble so far to make a systematic inquiry into the actual losses that occur in small plants in order to determine whether the apologetic utterance so often heard as to the low efficiency to be expected in small plants is or is not justifiable.

The object of the Professors' tests is to show the many directions in which economy can be effected in a small installation, but while this is of course quite right theoretically, it is also clear that unless skill is brought to bear upon schemes for increasing the economy of operation, it is quite possible to spend 20s. in saving 15s. The writer remembers the case of a "new broom" in one of the leading railways in the United States who triumphantly announced at one of the annual meetings of the officials to make up accounts, that by carefully checking and controlling the number of lead pencils that were served out to the clerks all over the line, he had effected a saving of something like $50, as compared with the previous year's lead pencil account. On inquiry, however, it appeared that he had appointed a special clerk to enter the number of lead pencils asked for against each applicant's name, so that no one should receive more than one lead pencil per month, and the salary of this clerk—not to mention postages and cost of stationery—was about $350 for the period during which he had been employed in checking the extravagant tendencies of the staff as to lead pencils. The cost of the pencils was 4 cents per dozen.

Let us consider what the losses in an electric lighting plant are, and the extent to which they may be unavoidable; we shall then be better able to judge as to the degree to which the losses in small plants are in excess of the "best possible economy," and as to the saving that could reasonably be made by skill and care in superintendence.

The most efficient steam boilers when working at 75 per cent. of their maximum load have not exceeded an evaporative efficiency of 85 per cent. with natural draught.

The most economical engine known, namely, the Nordberg quadruple expansion pumping engine, recently erected near Pittsburg for the Pennsylvania Water Company, gave 1 I.H.P. for an expenditure of 185·96 Th.U. per minute, the efficiency being $\frac{42{\cdot}42}{185{\cdot}96}$ = nearly 23 per cent.

The best electrical efficiency of a combined engine and dynamo or ratio of

$$\frac{\text{indicated horse-power}}{\text{electric horse-power at dynamo terminals}}$$

which has so far been published, appears to be 88 per cent.

Hence, assuming that such an efficiency as has been reached by the slow-running pumping engine above referred to could be realised in a direct coupled high-speed engine, the best possible result per thermal unit liberated in the furnace of the boiler would be $1 \times 0{\cdot}85 \times 0{\cdot}23 \times 0{\cdot}88$, the equivalent of 0·172 Th.U. at the dynamo terminals.

As a matter of fact, nothing like this is effected by even large plants in practice. Central station engineers are quite satisfied if they reproduce in electric energy at the generator terminals 0·05 of the heat energy liberated by the consumption of the coal; but the results of the working of some small plants must be terrible to contemplate if tests recently carried out by Profs. Swenson and Richter, of the Wisconsin University, are typical of what might be expected in practice.

The plant tested was a combined pumping and lighting station. There were two return tube boilers of about 43 H.P. capacity each. The engine indicated 125 H.P. at full load, and was belted direct to a 90-KW. 2,200-volt alternator. The feed water passed through an open exhaust heater on its way to the boilers. The pumps were two in number, each having a capacity of 400,000 gallons in 24 hours. The test was carried out between the hours of 5.55 p.m. and 1.15 a.m., when no pumping was done.

The watt-hours per pound of coal come out at 66·9.

The calorific value of the coal is not stated, but the

evaporation from and at 212° is put down at 6·45 lbs. of water. Assuming a boiler efficiency of 70 per cent. in the circumstances described in the test, the calorific value of the coal would be $6{\cdot}45 \times 966 \times \frac{10}{7} = 8{,}758$ Th.U. per pound. This is certainly low, but, from the description of the fuel (11·5 per cent. ash), not unexpected.

The watt-hour equivalent of the heat energy of 1 lb. of this coal would be 2,577, and the efficiency of conversion

$$\frac{67 \times 100}{2{,}577} = 2{\cdot}6 \text{ per cent.}$$

Comparing this with what might be expected from a large plant efficiently operated, it is $\frac{2{\cdot}60}{5{\cdot}00} = 52$ per cent., and comparing it with the best known possible, it is $\frac{2{\cdot}6}{17{\cdot}2} = 15{\cdot}1$ per cent. only of what could be achieved.

A considerable percentage of oxygen (13·43 per cent.) was found in the flue gases, which means that the surplus air passing through the furnace must have been considerable. Possibly the boiler efficiency was not as high as 70 per cent.

A loss of 2·54 per cent. of the steam raised is recorded between the boiler and engine. The steam pipe was uncovered, but it is to be hoped that this is not the usual practice in small plants, nor that it is usual "that the separator drain-cock was not kept entirely closed."

The degree of economy which can be effected in a small installation is necessarily much influenced by circumstances, and it is impossible to lay down any hard and fast rules on the subject, nor is it possible to dogmatise as to the degree of economy which should be realised. It may be safely said, however, that a 100-H.P. plant, properly designed with special regard to the conditions under which it has to work, show very much better results, even without highly-skilled supervision, than those recorded by Profs. Swenson and Richter.

THE PARIS TELEGRAPH FÊTES.

[FROM OUR SPECIAL CORRESPONDENT.]

Second Letter.

PARIS, *August 23rd.*

WE have just been able to get a complete list of the foreign delegates, and a summary cannot fail to interest your readers, as so many well-known names are included. The International Bureau of Telegraphs sent two delegates in the persons of Colonel Emile Frey, the director, and M. Eschbaecher, the vice-director. Germany sent some 200 delegates, but cards of delegateship could only be issued for 30, under the presidency of M. Schwieger, Director of Telegraphs. The president of the Austrian delegation, M. Bohuslav Schwamberg, engineer, brought with him nine colleagues, whilst Hungary sent seven, under the presidency of M. Pierre de Szalay, Director of Telegraphs. Belgium sent 36 delegates, which were divided into two parties, representing respectively the Postal and Telegraph Administrations. The first section was presided over by M. Dubois, inspector, and the second by M. G. J. Vanhove, inspector. Great Britain and her colonies were represented by 28 delegates, but the whole of the number did not put in an appearance. The following is the official list:—Mr. W. J. Stewart, postmaster, Leatherhead; Mr. Kehoe, postmaster; Mr. Legge, chief clerk; Messrs. Sawer, Manchester; Brown, Garland (London, C.T.O.); Hall, Telegraphs, Liverpool; Brimley, Hamilton, S. Marr, Heaviside, Welsh (Burmah), Nigel Jones (chief superintendent); Hill, Hutchinson, Leach, Madge, Olphert, Palmer, Styan (superintendent), Henderson, Hooper, Macrae, Sutherland, Traninger, and Williams Bell. Canada was represented by Mr. John Eagleson; Corea by M. Saltarel; Denmark by M. A. G. de Ellbrecht; and Spain by Senor Luis Cervero. The United States were represented by their Exhibition Postal Staff, which includes Mr. L. P. Moore, chief of office; Mr. J. C. Neill, assistant chief; and Messrs. W. A. Brown, Dorton, Kimball, and Howard Pruden. Italy was not represented. Japan sent two delegates; Luxembourg sent its director of posts and telegraphs, M. Felix Newmann; Mexico had two delegates present; Norway, eight delegates, under M. Hiorth, Postmaster; Holland sent 20 delegates, under the presidency of M. Van Ingen, Postmaster; Persia was represented by his Excellency Vezir Hemayoun, the Minister of Posts, and his Excellency, Mostechar-al-Vezaré, Councillor of Posts. Roumania's representatives numbered two; Russia's, two, which included M. Pierre Ossadtchy, Chief of the General Administration; Sweden sent eight and Switzerland 27, the latter delegation being under the presidency of M. Paul Piaget. The great telegraph and telephone companies also sent delegates as follows:—The Anglo-American Telegraph Company, one delegate, Mr. Gerald Fitzgerald, chairman; the National Telephone Company, one delegate, Mr. James Staats Forbes, chairman; the Nordiske Telegraf Sels Kab, three delegates, Col. V. E. Tychsen, Member of the Administrative Council, M. F. C. C. Nielson, and M. Kolvig; the Commercial Cable Company, two delegates, Mr. George Gray Ward, vice-chairman and general manager, and M. Leon Crozat, director of the Continental service; the Western Union, Mr. W. H. Axworthy and Mr. Slater; and the Eastern Telegraph Company, two delegates, Mr. T. Despecher and Mr. George Draper. Thus it will be easily seen that all the important postal and telegraphic administrations, except Italy, were represented at the *fêtes*.

Early yesterday an exchange of telegraphs with Italy took place, the following telegram being dispatched to Signor Pascolato, the Minister of Posts and Telegraphs at Rome.

"The presence of more than 800 delegates united in brotherly reunion, brings with it a keen regret for the absence of our dear Italian comrades. Will you please express our regret to your staff. Ansault, president; De Lirac, Secretary-General of *Fêtes*; Amiot, president of the French Delegation at the Centenary of the Electric Pile."

The following reply was received:—

"Accept our grateful thanks for your kind thought. Our delegate, M. Cardarelli, will repeat our message."

Minister of Posts and Telegraphs, Pascolato.

Telegrams of congratulations were received from the staffs at Milan, Bologna, and Innsbruck.

On Tuesday, August 21st, a special performance was arranged at the Opera Comique, which included selections from some of the best operas and plays, and gave us an opportunity of seeing the most celebrated performers of Paris. The programme consisted of the third act of "Cendrillon" (Cinderella), a fairy tale in four acts, after Perrault, the libretto being by M. Cain, and the music by Massenet. The singers were Madame Brejean Graviere as The Fairy, Mdlle. Guirandon as Cinderella, and Mdlle. Thompson as Prince Charming. A most delightful selection. A troupe of Spanish dancers gave an excellent performance, and then the third act of "Otello," with M. Mounet-Sully in the title *rôle*. Praise would be superfluous for this wonderful performance. Mounet-Sully was in his best form, and was magnificently supported by his brother, Paul Mounet, as Iago, and M. Debello as Cassio. Desdemona was played by Mdlle. Lara, and Emilia by Mdme. Wanda de Bonza. The fourth act of Gounod's "Romeo and Juliette" was then sung, the performers being M. Bartet as Brother Laurent, M. Affre as Romeo, M. Chambon as Capulet, Mdlle. Aino Ackté as Juliette, and Mdlle. Beauvois as Gertrude. The performance evoked a storm of well-earned applause. The one-act ballet "Phœbe" was also a most delightful selection, and the afternoon concluded with an entertainment by the celebrated Fregoli. The arrangements throughout were perfect, and the choice of performers and performance most successful.

During the *entracte* we had a chat with M. Baudot, the inventor of the celebrated telegraph apparatus bearing his name. M. Baudot is just recovering from a most serious mental illness, and even now is in a very low state. Several times during our conversation he appeared to lose his memory. It will, however, give pleasure to M. Baudot's many English friends to know that he is now sufficiently recovered to leave home, although still requiring the greatest

attention. He seemed much gratified by the thought that inquiries were made about him in England, and takes the keenest interest in the success of his apparatus, which has been on trial in the English Post Office for some two years.

Yesterday, Wednesday, August 22nd, an excursion was made to Versailles. The embarkation took place at the landing stage at the Pont Royal. Two large boats were loaded with delegates, and a most pleasant trip was made as far as Saint Cloud. A walk was made through the Park, which lost much of its charm because of a rather heavy downpour of rain. Despite the depressing weather, the delegates managed to keep up their spirits. Two special trains took the party to Versailles. Here a luncheon was given, but so large was the number of those present, that it was found necessary to divide them among four of the best restaurants of Versailles. A visit was then made to the Chateau under special guidance, and a tour made round the Park.

The Mayor of Versailles held a reception in the Theatre (the Town Hall being under repair) and offered some excellent light refreshments. M. Ansault, the President of the Organising Committee, in a delightful little speech thanked the Mayor for his cordial hospitality, which had added another charm to the many charms and treasures of Versailles. The Mayor, in reply, expressed his pleasure at having so distinguished a company in his native town, and also his regret at having been able to do so little for them. He could only assure them that the little he had done was done with a warm heart. The delegates returned to Paris by the 5.36 special train, reaching that city shortly after six. During the stay at Versailles, a special display of the Grandes Eaux was made, this being a most exceptional favour. In the evening the Paris staff invited the foreign delegates to spend an evening with them in "Vieux Paris" at the Exhibition. Dancing and short speeches brought the day to a close. It was generally voted a most excellent day's entertainment.

LOAD FACTORS ON TRACTION STATIONS.

By Wm. H. BOOTH.

In the power house of an electric tramway the conditions of working differ essentially from those of a lighting station. In the latter, assuming ordinary conditions, there is a more or less steady daylight load that can be dealt with by one or more steam engines loaded to their maximum economy. As night comes on, and with it a steadily increasing load, this can be foreseen and prepared for sufficiently to secure that the plant is loaded approximately to its most economical load. There are no sudden variations of great magnitude. When the highest peak of the load curve has been reached, the load curve begins to fall away again to a minimum, and engines are put out of work as the ammeter shows it to be necessary to do so. The load factor of a lighting station is poor in the sense that the time during which maximum power is being developed, is only a fractional part of the day, that is to say, in other words, more of the steam power stands idle through the greater part of the day, and is used only for the short period of heavy load.

In a tramway station the load factor is poor likewise, but it is poor in a different sense from that of the lighting station. The diurnal load curve is comparatively level as a mean curve. It will usually attain its maximum in a short time, and will remain at a maximum all day, and drop at the close of the day as the cars are shedded. There will be waves in the mean curve due to extra loads at certain hours, but these will not be of very serious moment. But the mean load curve is exceedingly irregular throughout. The mean curve is made up of a series of rapidly recurring peaks and depressions, the current output of the station varying from 0 to maximum all through the day. Except when cars are going out in the morning and coming back to shed at night, there is no time during the day when the full power of the running plant may not be called for. The maximum engine power used in the station must, in fact, be put to work soon after starting up, and must be run all day. But the load factor of the plant is small. The minimum power that it is possible to employ in a traction station without accumulator is that which will deal with the maximum load on the station without seriously reducing the engine speed at any time. It is justifiable to permit the engines to fall in speed for two or three seconds when the maximum current is being drawn by the line, because the maximum current is of very infrequent occurrence, and it would be uneconomical to provide so much engine power and fly-wheel energy as would carry over the maximum at full speed. The maximum current endures for so short a period as to render such slowing down of very small account. It is evident that the engines in a traction power house cannot be worked at their economical load, for they must be sufficiently large to deal with their full load in the manner above indicated, while they are often working at a very small load indeed, and even if economical at mean load they must be wasteful at both extremes of loading. This question recently received some attention in my article on simple and compound engines (Electrical Review, June 15th, 1900,) in which I discussed the possibility of simple engines being worked more economically than compound engines, by reason of the fact that the simple engine can be made to drive loads much greater than can be brought within the scope of compound engines, and therefore do not require to be so abnormally large in order to cope with the peaks of their load curve whereby they would become wasteful at other loads. In order to be able to gain some idea of the conditions under which a projected plant will work, it is necessary to know what are the load factors to be expected. It is very evident that no system of theoretical mathematical calculation of permutations and combinations can be relied upon to fix the ratio of mean to maximum or minimum load. In a tramway system running one car, a fair approximation may be made to this ratio. The car will sometimes be at rest. At such times it will take no current. The station output will be *nil*. The maximum output will occur when the car is fully loaded and is starting up hill on the maximum gradient with the least skilful motor man. The mean current will be, say, 8 amperes, the minimum will be 0, and the maximum perhaps 50 amperes. The load factor of such a line is thus $\frac{8}{50}$, or 16 per cent. It is also obvious that with two cars there will be frequent coincidences of stopping, when the current will be *nil*, and frequent approximate coincidences of starting, when the current will approximate to double that of the single-car system. But the two cars would not be both starting up the maximum incline together, and the actual maximum current would be something less than that with the one car, and it is evident that as the number of cars is increased the frequency and intensity of maximum peaks is reduced and the occurrence of periods of no current is less frequent, and very soon ceases altogether. The load curve of a station is thus made up of an almost random superposition of as many single car-load curves as there are cars on the line. Given a sufficient number of such curves and their mean would become a straight line, and we should say the load factor was 100 per cent. It is probable that no empirical formula of simple form could be discovered that would give for all stations the load factor. The points to be taken into account are, among others, the number of cars on the line, the gradients, type of car, speed, service, and so on. But it is reasonable to suppose that with a sufficient number of systems to compare, an approximate formula of simple form might be discovered that would enable us to foretell the load factor from the forecast of the traffic. Such a formula has appeared to me to be capable of attainment after a comparison of a number of systems and their statistics of car mileage and units generated. The formula deduced holds good within small variations through a wide range of practice, and is easily applied, and can be deduced from the readings of the recording ammeter. The rule is $F = 1{\cdot}33 \sqrt[3]{V}$ where F is the load factor and V is the number of units generated in the station in a complete week of seven days. The constant 1·33 will not hold good for every case, but for all cases so far tested it is a mean value, and in no case does the actual value fall far on either side. To illustrate the rule we may suppose a one-car service of 750 miles per week consuming, say, 738 units. The cube

root of 738 is 9·03, and $9·03 \times \frac{4}{3} = 12·04$, a figure that will fairly represent the load factor on such a system. Again, we will take a small system that consumes 4,281 units per week. The cube root is 16·2, and this increased by one-third is 21·6 per cent. The actual load factor was 22·2, a sufficiently close approximation to point to some value in the formula. Let a third example be taken higher, say at 31,500 units per week. The root is 31·6, and the load factor is thus 42·1, the actual factor being 40·8. Take another case which does not yet obtain in actual practice, namely, the station generating 422,000 units per week. Here the cube root is 75 and $75 \times \frac{4}{3} = 100$ per cent. Thus by the rule when the weekly output exceed 400,000 units, the load factor becomes 100 per cent., and there is an absolutely steady load on the power plant. Clearly any additional mileage on such a station would show a load factor of over 100 per cent., which is not possible, and the rule fails as a mathematical expression, but may it not be fairly assumed that any station having a legitimate load of 400,000 units per week, would have practically a steady load. It would have 600 or 800 cars over a wide area of many different descriptions, and it cannot be doubted that the load would be steady, and even with an output of probably 6,000 amperes. It is probable that if the formula were corrected so as to take into account the average hourly output, it would be capable of more general application, because as at present deduced, it is derived from the weekly output of a number of stations running the number of hours daily, usual in British practice. Reduced to the hour basis it may be said that the station load factor will be seven times the cube root of the hourly units or $F = 7 \sqrt[3]{V}$, a simple enough expression that gives close approximations to actual practice, both in established stations and in stations that have increased steadily from small to large outputs, the rule holding good throughout the rise.

The data to hand are not sufficient to show the influence of different types of cars, but the inference is that the tendency of larger cars will be to slightly reduce the load factor, for it is certain that the basis of load factor is the number of single car load curves of which the mean curve is composed, and that a truer basis on which to work would be the number of cars at work, rather than the total units generated. Experience, however, teaches us that in large systems, which are the more likely to employ large cars, the number of units generated in a given time represents a greater number of cars on the line than would be represented on a small system proportionately to the output, because on a small system a greater mileage is usually obtained per car. On the other hand, a large car represents more units consumed. The two factors tend to counteract one another, and the use of units generated as a basis in the formula does not vitiate results in any case of ordinary practice. Assuming that the rule is found to hold good, it becomes easy to forecast the probable mean and maximum load on any projected system, and it should enable the relative economy of different types of engine to be arrived at. It also points to the economy to be gained by electrically connecting the whole of the mains on any system, whether fed from one or more stations, because only by a large number of cars being run off one electrical system can any respectable load factor be secured. It is improbable that a mean half load on the power plant can be secured with less than, say, 100 cars on the line. The importance of thus ascertaining the load factor is not confined to the question of engines. It applies with equal force to boiler calculations. With a load factor of 33 per cent., for example, it would be folly to put in boilers capable of supplying steam for the full power of the engines. It would not be correct to put in boilers of 33 per cent. capacity because the underloaded engine would be wasteful, and would probably demand a boiler capacity of 50 per cent. Boiler capacity, however, is, perhaps, more easily determined from experience of existing stations and the amount of fuel known to be burnt per car-mile. It follows that in a well-designed station engine tests of full and 25 per cent. overload cannot be run with the working boiler power. Each engine thus tested will require its own and the spare boiler in the familiar instances of stations with one boiler for each engine.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

14,449. "Improvements relating to double-pole three-way and similar electrical switches." E. E. Bartlett. Dated August 13th.

14,450. "Improvements relating to electrical controlling and regulating switches." E. E. Bartlett. Dated August 13th.

14,458. "Improvements in telegraphic relays." C. E. Wilson. Dated August 13th. (Complete.)

14,463. "Improvements in apparatus for electrolysis." P. Schoop. Dated August 13th.

14,488. "A method of electrically reversing the direction of elevators driven by electricity." R. Haddan (A. Stigler, Italy.) Dated August 13th.

14,495. "Improvements in or connected with automatically opened switches." T. Hesketh. Dated August 14th.

14,506. "Improvements in and relating to dynamo-electric machinery." A. G. Brookes. (C. L. Cotton, United States.) Dated August 14th. (Complete.)

14,525. "Improvements connected with controller brushes." J. Y. Johnson. (The Riker Motor Vehicle Company, United States.) Dated August 14th. (Complete.)

14,550. "Improvements relating to the insulation of electric conductors." H. H. Lake. (N. Tesla, United States.) Dated August 14th. (Complete.)

14,552. "Improvements in conduits for electric conductors water or the like." H. Tugby. Dated August 14th.

14,556. "Improvements in or connected with pipes, conduits, or the like." J. J. Bate. Dated August 14th.

14,557. "Improvements in or relating to conduits for electric conductors." J. J. Bate. Dated August 14th.

14,558. "Improvements relating to the transmission and receiving of telegraphic signals." G. F. R. Blockmann. Dated August 14th.

14,568. "Improvements in toll collecting machines for telephones." R. Haddan. (The American Toll Telephone Company, United States.) Dated August 14th. (Complete.)

14,582. "Improvements in and connected with electric furnaces." R. Chavarria-Contardo. Dated August 14th. (Complete.)

14,608. "Improvements in electricity meters." S. H. Holden and Chamberlain & Hookham, Limited. Dated August 15th.

14,633. "An improved system of electric lighting and apparatus or devices therefor." P. Lapertot, G. Villard, and L. Pignaud. Dated August 15th.

14,637. "Improvements in and connected with apparatus for punching strips of paper and like material suitable for use in telegraphic transmitters and for like purposes, the same being particularly adapted for the preparation of telegraphic messages for automatic transmission over single or duplexed circuits which may be received in Morse or other telegraphic codes or type-printed characters arranged in page form." W. L. Wise. (C. L. Buckingham, United States.) Dated August 15th. (Complete.)

14,688. "Improvements in or connected with incandescent electric lamps." H. E. Moul. Dated August 16th.

14,691. "Improvements connected with electric primary batteries for traction purposes." S. W. Maquay and T. G. Chambers. Dated August 16th.

14,704. "Improvements in transmitters for electrical waves or the like apparatus." C. G. G. Braunerhjelm. (Date applied for under Patents, &c., Act, 1883, Sec. 103, January 26th, 1900, being date of application in Sweden.) Dated August 16th.

14,715. "Improvements in and relating to thermo-electric apparatus." W. E. Evans. (La Société Ginestes et Cie, France.) Dated August 16th.

14,723. "Improvements in magnetic cut-out apparatus." L. Andrews. Dated August 16th.

14,743. "Improvements in electric cut-outs and the like." H. F. Clayton. Dated August 17th. (Complete.)

14,759. "Improvements in electric traction." E. H. Tyler and A. G. Hansard. Dated August 17th.

14,794. "Improvements in apparatus for use in wireless telegraphy." T. J. Bowlker. Dated August 17th.

14,798. "An attachment to ceiling roses for raising and lowering central hole weights or fixing electrical fittings." R. W. Braham. Dated August 18th.

14,841. "Improvements in means and apparatus for telegraphing and controlling various mechanisms from a distance without wire or other like connections." J. T. Armstrong and A. Orling. Dated August 18th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

18,702. "Improvements in electricity accumulators." A. Schanschieff. Dated September 1st, 1898. The plate or grid is made with a number of rectangular or circular holes through it, the margins of which are inclined so as to form grooves or channels. Two such plates may be placed one on the other and then burned together, and, if plates with circular holes are employed, those in the one plate break joint with those in the other. 3 claims.

18,722. "Improvements in clips for attaching to telephone or other cables when drawing the same into pipes or conduits." J. G. Brien. Dated September 1st, 1898. Telephone and other cables to be drawn into pipes or conduits are provided with clips to which the hauling ropes are attached. Consists in a frame slightly conical on its inner surface and having extension arms joined by a cross piece. A screw works through the cross piece and presses by means of a plate on the ends of toothed wedges, for gripping the cable. The outer end of the screw has an eye. The screw may be omitted, and the wedges otherwise caused to grip the cable. 3 claims.

18,740. "Improvements in safety fuse apparatus for electrical installations." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien-Gesellschaft.) Dated September 1st, 1898. Relates to improvements in fuses provided with shutters such as described in Specification No. 24,020, A.D. 1895. On the base is fixed a pediment on which is fitted a cement block slotted to receive the fuse and the shutters. The block also carries the spring contacts for the fuse and the terminals for the conductors, which are led in through porcelain blocks fixed to the base. The cover has a double top in which are fitted springs adapted to force down the shutters when the fuse blows. It is secured in position by springs fixed on the base and engaging with catches on the cover. The fuse is fitted with oval blocks which are readily slipped into the contacts and turned by a lever into good contact. 3 claims.

18,743. "Improvements relating to the extraction of chromium by electrolysis." J. F. L. Moeller and E. A. G. Street. Dated September 1st, 1898. A process for electrolytically extracting chromium from salts having a chromium-sulphate base, wherein all the products obtained in the anode compartment are utilised in the cathode compartment. Where chrome-alum solution is used in the cathode compartment, and acidulated water in the anode compartment, the residual liquid of the anode compartment is treated with sulphurous acid to convert the chromic oxide into sulphate. The excess of sulphurous acid is boiled off, sodium bichromate is added, and the liquid is allowed to fall in streams into a lead vessel containing sulphur at 130° C., whereby chrome alum is obtained, which, after adding water and filtering, is passed to the cathode compartment. The cathode liquid gradually becomes charged by the working with sodium sulphate from which it is purified by circulating the liquid, and cooling it down to allow the sulphate to crystallise out. The solution is then enriched with chrome alum, formed as above, and returned to the cathode compartment. When chromium sulphate solution is used in the cathode compartment, the liquid leaving the anode compartment is treated with sulphurous acid, then saturated with hydrated chromium oxide, and passed to the cathode compartment. The chromium oxide required for this purpose is obtained by boiling a sodium-bichromate solution with an alkaline or alkaline-earth sulphide, the chromium oxide being precipitated. The sulphide is afterwards regenerated by heating the sulphate formed with carbon. When porous partitions are not used, the increase of acidity due to the liberation of sulphuric acid is neutralised by additions of hydrated chromium oxide, and the chromic acid formed is neutralised either by alkaline or alkaline-earth sulphides, or by sulphurous acid or chromium sulphide. To indicate the rate of deposit of chromium, a rod of a predetermined diameter is mounted in parallel upon the circuit traversing the rod or rods upon which the deposit takes place, under such conditions that it receives a deposit which will not thicken when the bath is at its normal degree of acidity. The indicating rod may be removed from the bath for inspection, or it may be connected with a balance so as to show by the movements of the arms thereof, if the acidity is as required. Lead anodes are employed, the lead being preserved from attack by a regulated supply of water and overflow of liquid to prevent the excessive concentration of the acid. Under these conditions the anodes become peroxidised, and have a very long life. The cathode may be sheet-copper or brass, and the temperature of the bath 70° C. The cell yields about 0·2 gram of chromium per ampere hour with a continuous current of a density of 40 amperes per square decimeter of cathode surface. 4 claims.

18,754. "Improvements in electric tramways and railways on the conduit system." J. C. Love. Dated September 1st, 1898. Relates to collectors for electric railways and tramways on the conduit system. The shank is made of two plates enclosing the conductors, and is attached to the socket by a pin. This socket is open on one side for access to the wires, and it is hung so that it can swing and slide between stops on a rod carried on the vehicle framing. Sliding contacts or flanged wheel contacts are carried by arms hinged on brackets at the lower end of the shank. The former preferably rely for contact on their own weight, but springs can be applied in the two forms as shown. Conductors are mounted in insulating blocks, and clamps as described in Specification No. 17,984, A.D. 1898, and the joints are made with fishing bars connected by a bolt between the ends of the conductor. One bar may be brazed to one end of the conductor, and one fishing bar is tapered off towards its end. 7 claims.

18,806. "Improvements in telephonic apparatus." A. Graham. Dated September 2nd, 1898. Relates to the arrangement of telephonic apparatus for use on board ship and other exposed places to protect it from water, &c. A waterproof case is provided with an inwardly projecting tube which fits a downwardly and forwardly projecting tube from the receiver. The receiver diaphragm is clamped between two rings, and the magnet coils are mounted on pole-pieces attached to a semi-circular magnet with inturned radial ends. The transmitter is of the type described in Specification No. 591, A.D. 1898. The carbon block is mounted in a block, and is provided with a soft seating. The carbon diaphragm has a metal foil facing, and there is a reticulated protective screen. The screw-heads are protected by solder, and any metal joints are similarly rendered waterproof, other joints having an insulating varnish such as shellac. The microphone is provided with an external handle and is mounted in bearings so as to be rotated; the rearward extension consists of a shaft and returning spring. Contacts and contact springs are arranged in connection with the shaft for connecting the battery first directly to line and then to line through the microphone, and also for connecting the bell and receiver alternately to line. The transmitter and receiver are connected in separate lines, the transmitter at one station being connected to the line of the receiver at the other station. 8 claims.

18,807. "Improvements in electric sparkers for explosion engines." A. Winton. Dated September 2nd, 1898. The igniter automatically times itself according to the speed at which the engine is running, and is consequently very suitable for motors for propelling vehicles. A cam gradually raises a rod against a spring, and presses the sparking terminals together, and then suddenly allows it to fall, thereby separating the terminals and producing sparks in the admission port. There is a spring connection between the rod and the terminal. For adjusting the ignition according to the speed, the rod is pulled against a face cam by a spring so that as the speed increases the rod is thrown further away from the faces and slips off the edge of the cam earlier, and so produces an earlier ignition. 8 claims.

18,847. "Improvements in electric batteries." M. E. Tuld. Dated September 3rd, 1898. Consists in a method of constructing battery cells, and especially those of dry batteries, and of mounting or supporting them so that a cell may be conveniently removed and replaced by another. The cell casing is made with two recessed parts, into which the ears on insulating caps which close the cells, and the two are fastened together by screws or pins passed into the cap through holes in the casing. The electrodes may be zinc, which may also be semi-circular in form, and silver chloride immersed in an electrolyte of zinc sulphate. The electrodes are separated by insulating pieces, which are not at the edge to prevent them from bursting the cell when they expand. The cell is closed by four successive layers, firstly, a plastic substance which is allowed to harden; secondly, a viscous substance; thirdly, a layer of plaster of Paris which is inserted under a slight pressure and allowed to harden; and lastly, a thicker layer of plaster of Paris which is also inserted under pressure. The glass cell is indented at the top to hold these layers in place. The conducting wires pass through sheaths and through the covers, and are then turned down under lugs which are held down by screws passing into the covers and through the support being held thereon by nuts. The terminals are connected together by slotted strips of metal. A porous substance placed in the casing absorbs any electrolyte which may escape. The casings may be made large enough to hold two or more cells. 7 claims.

18,854. "Improvements in electrically igniting charges of internal combustion engines." A. F. Evans. Dated September 3rd, 1898. One electric terminal is secured in the cylinder cover by nuts and insulated by packing. The other is a lever on a spindle, and is pressed against by an eccentric rod moving in a pivoted guide, and carrying an adjustable tappet which engages a projection turning freely on the spindle, and connected to a lug fixed on it by a spring. The projection is suddenly released as the tappet passes it, and contact is broken between the parts. The sleeve carrying the spindle passes through the cylinder jacket. 2 claims.

18,864. "Improvements connected with electrical signalling or communication on railway trains." A. Shiels. Dated September 3rd, 1898. Relates to means for preventing the alarm bell and indicator semaphore from being operated by the oscillation of the train. As applied to the bell mechanism, a two armed piece is pivotted between the pole-pieces of the electro-magnet, so that in its normal position, the heavier arm acts as a stop to prevent the movement of the armature which carries the bell hammer. When the magnet is energised, the piece is drawn into position and permits the operation of the hammer. As applied to the indicator, the semaphore arm is normally locked in its raised position by a catch, which is released by the movement of the armature when the latter is attracted to its magnet. 2 claims.

18,867. "New or useful electric switch device for the temporary lighting of staircases, floors, cellars, and the like, also for indicating the heating of shafts and bearings and for fire alarms." W. Blanckenhorn. Dated September 3rd, 1898. Relates to switches for temporarily lighting places such as stair-cases, &c., for indicating the heating of bearings, for use as a fire-alarm, &c. The essential part of the apparatus consists of an egg-boiler-shaped receptacle containing mercury. In the narrow neck are fitted two contacts connected to a loop or bell circuit. The receptacle, in the construction shown, is mounted in a pivoted frame, which, when partly rotated by the pin, causes the mercury to run past the contacts and so complete the circuit. When the apparatus is to be used for indicating the heating of a bearing or shaft, or as a fire alarm, the frame is modified and connected to the bearing or support, and the contacts are so arranged that the expansion of the mercury due to excessive heating closes a circuit. The appliance may also be fitted as a fire alarm in the circuit of an ordinary door switch. 4 claims.

18,941. "Manufacture of homogeneous mixtures for the incandescence bodies of electrical glow lamps." C. D. Abel. (Allgemeine Electricitäts Gesellschaft.) Dated September 5th, 1898. Relates to incandescent lamps. Homogeneous mixtures of metallic oxides for making filaments are prepared from aqueous solutions of their mixed salts, such as chlorides or nitrates, either by evaporation and heating, or by precipitation by alkalies or other reagents, or by electrolysis. 1 claim.

18,956. "Improvements in or connected with electrolytical condensers and electric driving directing devices." C. Pollak. Dated September 5th, 1898. Relates to improvements upon electrolytic cells for use as condensers, &c., such as are described in Specifications Nos. 1,069, 1896; 23,442, 1897; and 933, 1898. The electrodes are made of materials such as aluminium, lead, &c., which have the property of becoming coated with and insulating-layer. The electrolytes may consist of the following:—(1) alkaline salts of phoshoric acid; (2) alkaline salts of organic acids belonging to the fatty series which contain (*a*) two or more groups of oxalic acid or (*b*) a group of oxalic acid combined with one or more oxy groups (malic or tartaric acid), or keto groups or aldehyde groups; (3) alkaline salts of organic acids of the aromatic series; (4) organic acids of the above series without alkalies. The electrodes should be prepared by coating them electrolytically, using a current of high potential. 1 claim.

18,958. "Improvements relating to the electrolytic decomposition of alkaline salts." E. Edser. Dated September 5th, 1898. Relates to the electrolytic decomposition of alkaline salts, more especially for the production of alkaline hydrates, in which process an amalgam of the alkaline metal is formed as an intermediate product. In one form of apparatus the cell is provided with central carbon anodes and outer cathodes preferably formed of metallic frames upon which iron wire is stretched or woven. Separating the cathodes and anodes is a vertical series of troughs containing mercury, the lower edge of each trough dipping into the mercury in the trough below, the whole series, together with the upper plates dividing the cell into two compartments. The inner compartment is charged through a bottom opening with brine, the weakened brine flowing away through a pipe at the top. The outer compartment is charged through a pipe near the top with water or a weak solution of caustic alkali, while caustic alkaline solution is drawn off from the lowest part. In use, the brine is decomposed, chlorine being evolved and collected by a hood while the sodium combines with the mercury in the troughs, forming an amalgam which is decomposed in the outer sides of the troughs, mercury again reforming, and a solution of caustic soda being produced, while hydrogen is given off and may be collected. A modified form of this construction is also shown in which the current may be conducted away by means of the plate, the formation of the hydrate from the amalgam, being, under these conditions, produced without the use of the current. A high efficiency can be obtained by causing a greater current to pass through the brine solution than through the alkaline solution by providing a wire of suitable resistance between the mercury cathode and iron cathode, and by connecting the carbon anode and iron cathode with the source of supply. 7 claims.

19,014. "Improvements in apparatus for starting electric motors." J. Burke. Dated September 6th, 1898. Relates to an alternating current motor supplied from constant-pressure terminals which is started by current from the secondary of a pressure-reducing transformer. The arrangement of contacts can only be described with reference to a diagram and therefore is unsuitable for abridgment. The invention is applicable to continuous-current motors, the transformer being any suitable converter. 18 claims.

19,071. "An improved system of recording telephonic messages." W. Aitken. Dated September 7th, 1898. Relates to telephone systems in which the subscribers' apparatus is provided with counting mechanism. One arrangement is described in which a subscriber is provided with a galvanometer and a polarised counter-magnet which are only in circuit when the receiver is on the hook. A special signalling key is provided for sending intermittent currents when any difficulty arises. The exchange operator has the plug lines divided by condensers and bridged by a double wound impedance coil, the middle point of which leads to the clearing-out annunciator and battery for effecting the recorder. The second clearing-out annunciator and battery which will not operate the polarised recorder, are in the circuit of the calling plug. In a modified form, the recorder is in a circuit with a polarised relay controlled by the switch lever. The exchange is provided with a transformer divided plug circuit, one side of which contains the armatures of a relay for reversing the poles of the exchange battery, the coil of the relay being in circuit with a phonograph which gives the engaged reply to a subscriber calling. 7 claims.

19,076. "Improvements in wall connections for electric lighting." A. P. Lundberg and G. C. Lundberg. Dated September 7th, 1898. Relates to the arrangement, &c., of the terminals and connecting pieces in wall sockets. A porcelain block or base is formed with vertical holes for the reception of the cylindrical contacts and with horizontal perforations for the locking-screws. Perforations are also formed for the leading-in wires. In one form the contacts are locked by eyelet screws which pass through the shaped slots and are secured by nuts. The leading-in wires are pinched by the screws. In modified forms the contacts and terminals are secured together by screws fitting in suitably-formed slots. 3 claims.

19,110. "An improved method of suspending curtains, electric lamp wires, and other articles." P. Ogden. Dated September 8th, 1898. The wire leads of an electric lamp are suspended from stems fixed to runners working in grooved strips or slotted tubes fixed to the ceiling of a room, &c. 1 claim.

19,116. "Improvements in or relating to shields or guards for the carbon pencils used in electric furnaces." J. Bastick. Dated September 8th, 1898. A carbon electrode is protected, except at the end, by an iron or gun-metal casing, filled or lined with asbestos, fireclay, or other non-conducting material. The casing is movable along the electrode by a rack, pinion, and hand-wheel carried by bearings on the holder in which the carbon is wedged; or a screw or other adjustment may be used. A clamping screw and nut are also provided, the casing being slotted to pass the screw. The invention may be applied to the furnace described in Specification No. 29,011, A.D. 1897. 2 claims.

19,162. "Means and appliances for indicating at one end of an electric circuit the position of an arm or pointer at the other end of the circuit." P. Rabbidge. Dated September 8th, 1898. Relates to a system of indicating at one station the position of an arm at the other. Various applications are referred to, such as ship (including steering), and house telegraphs, station indicators on trains, &c. A rheostat has a rotating arm at one station connected in series with a battery, key, and ammeter having a pointer which follows the movement of the rotating arm. The rheostat may be in shunt instead of series, or a number of cells may take the place of the rheostat and a voltmeter be used in place of the ammeter. 3 claims.

20,045. "Improvements in electric safety fuses." W. L. Wise. (Actiengesellschaft elektricitatswerke vorm O. L. Kummer & Co.) Dated September 21st, 1898. Relates to the class of fuse in which a wire is threaded through a hole in a porcelain block which can be readily removed or replaced. The block has a female screwed sleeve adapted to fit on a screw and the current flows from one terminal on one side of the base to a contact, fuse wire, and screws to the other terminal. The fuse wires are made of different thicknesses, and the length of the screwed sleeve is made to correspond, so that an unsuitable fuse may not be accidentally fitted. The length of the screw may be adjusted by a special key which is fitted over a nut. 1 claim.

21,046. "Improvements in prepayments electric meters." The British Thomson-Houston Company, Limited. (Ectlic.) Dated October 6th, 1898. The coin issuing from a shoot completes the circuit between a pivoted trap and a couple of posts, one bearing a spring which reaches to the other. A disc bearing a few teeth is driven slowly by the meter, and periodically frees the trap, so that a spring flicks it to drop one coin and catch the next. 8 claims.